GOES-R PROGRAM REQUIREMENTS DOCUMENT

VERSION I

for the

FOLLOW-ON GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (GOES-R SERIES)

June 14, 2004

GOES OPERATIONAL REQUIREMENTS WORKING GROUP (GORWG)
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1 GENERAL DESCRIPTION OF PROGRAM OPERATIONAL CAPABILITY

1.1 DOCUMENT PURPOSE AND SCOPE

The purpose of this document is to establish the high-level system requirements for the next generation Geostationary Operational Environmental Satellite series, designated the GOES-R series. The GOES-R series is required to provide continuity and improvement of remotely sensed environmental data from a geostationary orbit in the 2012-2025 era.

Historically it has been shown to take a minimum of ten years from requirements validation to spacecraft launch for acquisition of an initial or follow-on operational satellite system. Since 1998, activities have been on-going for the GOES-R series in terms of collecting preliminary requirements from selected high-priority operational users and scientific communities, translating these requirements into preliminary instrument technical documents and conducting initial concept, trade, and cost studies and analyses. Now in 2003, ten years prior to launch, the time is at hand to document a complete set of requirements, representing all users, and addressing all program segments to initiate the GOES-R series acquisition process.

This Program Requirements Document Version I (PRD I) represents a consolidated collection of the extensive GOES-R series system requirements previously provided in numerous individual documents. These documents include:

- Operational Requirements Document (ORD) for the Evolution of Future NOAA Operational Geostationary Satellites, NOAA/NWS, January 1999.
- NOAA's Technical Requirements Document (TRD) for a Geostationary Advanced Baseline Sounder (ABS), Final Version 1.0, NOAA/NESDIS, 20 December 2001.
- GOES-R Series Preliminary Mission Requirements, NOAA/NESDIS, June 2001.
- NOAA's Technical Requirements Document (TRD) for the GOES-R Communication Links, Draft Version 1.0, NOAA/NESDIS, 26 September 2001.
- Ocean Observer User Requirements Document, Version 2.6, NOAA/NESDIS, 15 October 2001.
- Integrated Operational Requirements Document (IORD) II for the National Polar-Orbiting Operational Environmental Satellite System (NPOESS), 10 December 2001.
- NOAA's Technical Requirements Document (TRD) for a Geostationary Advanced Baseline Imager (ABI), Final Version 1.09, NOAA/NESDIS, 25 February 2000.
- NESDIS Consolidated Product List (CPL): Geostationary Operational, Developmental and Experimental Products, January 2002.
- Comprehensive Large Array-data Stewardship System (CLASS) Archive and Access Requirements, Draft Version, CSC, January 29, 2002.
- Space Environment Monitor (SEM) for the Geostationary Operational Environmental Satellites (GOES-R) Operational Requirements Document (ORD), NOAA/SEC, Version 2.00, 05 February 2002.
- GOES-R Series Users Workshop September 19-22, 2002, Executive Summary and Presentations Summary, NOAA/GOES-2000.
- Future GOES Series User's Conference, May 22-24, 2001, Summary Report, NOAA/GOES-2002.
- Second GOES User's Conference, October 1-3, 2002, Conference Report, NOAA/GOES-2003.

- McMullin, Donald R., Report of the GOES-R+ EUV Sensor Workshop, Held at NOAA Space Environment Center, Boulder, CO, October 28-29, 2002, Rev. 1.1, January 29, 2003.
- Mazur, J. E., Summary Report of the Workshop on Energetic Particle Measurements for the GOES-R+ Satellites, Held at NOAA Space Environment Center, Boulder, CO, October 28-29, 2002, January, 2003.

Other documents are listed in Appendix B and are cited in the text in the following style: [*Operational Requirements Document*].

The requirements in the GOES-R Operational Requirements Document Version 0 (GORD 0) were taken primarily from existing documentation of National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) requirements in the areas of imagery and sounding and NOAA's Space Environmental Center (SEC) requirements for solar and space environment sensing, all at the space segment level. The requirements in this PRD I have undergone validation and form an initial (nominal) operational baseline and should facilitate continuation of instrument design and cost studies. It is the intent of this Version I to be used to continue the formal collection, documentation, refinement and validation of GOES-R series requirements. New and revised program requirements will be managed and controlled through a structured management process. As a result of further user requirements analyses, trade studies, and full end-to-end segment analyses this PRD I document will be refined and reissued as PRD II.

A parallel effort is on-going in NESDIS to generate a comprehensive document, Consolidated Observational Allocated Requirements List (CORAL), listing all NOAA *agency* space-based environmental observational requirements and benefits. The appendix to that document, allocating specific observational requirements to the geostationary orbit, will contain higher-level justification for the requirements and benefits that ordinarily would not be in a geostationary *system* level ORD. This document does not specify solution sets to meet the requirements.

PRD I has been streamlined to list all segment level requirements in Section 3, achievable by the notional GOES-R series, along with descriptions of requirements evolution resulting from technological trades and cost constraints. Section 3 of this PRD I also lists those Pre-Planned Product Improvements (P^3I) that are anticipated to be available at some time during the GOES-R series development, after the initial operational capability. Section 3 also addresses the requirements for product processing, archive, and user interface segments.

This intermediate version, PRD I, includes requirements from all NOAA Line Offices in addition to NWS—the NOAA Ocean Service (NOS), NOAA Research (OAR), NOAA Fisheries (NMFS), NOAA Marine and Aviation Operations (NMAO), and NOAA Satellites and Information (NESDIS). These data form a national information database and infrastructure that can be used by other governmental agencies, the private sector, the public, and the global community. The needs and impacts of some other U.S. federal agencies, private industry, the public and foreign governments have also been considered.

The final requirements document, PRD II, is intended to be the GOES-R system level requirements document linking agency observational requirements allocated to the geostationary orbit to follow-on lower level segment technical specification documents. Figure 1-1 illustrates this linkage. Thus, this document represents the balance achieved between user needs, system technical capabilities and program cost constraints.

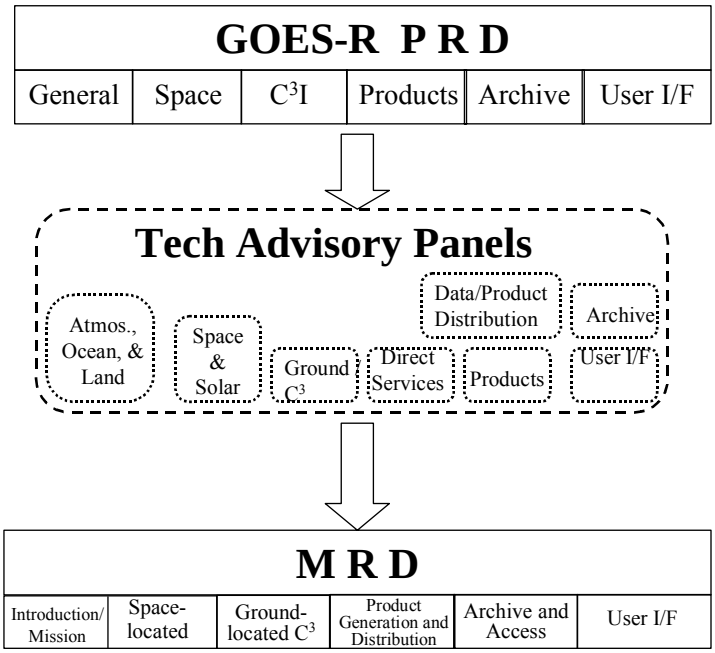

Figure 1-1. GOES-R PRD to Mission Requirements Document linkage.

The scope of these documented requirements is comprehensive and consistent with the broad scope of the GOES-R program, spanning all technical elements of the program. The scope reflects the intent to conduct a complete end-to-end documentation of requirements to include not only the traditional Space and C^3 segments of an operational environmental satellite program but also the Product Processing and Distribution, Archive and User Interface segments. For those elements of the future program undefined at this time, they will either be specified at a high level requiring further analysis and detail or be identified as "to be determined" (TBD).

The schedule for release of PRD versions is as follows:

GORD 0: February 2002

- consolidates requirements to date
- provides baseline set of requirements to direct trade and cost studies
- to be used to document all NOAA and additional user requirements
- to be used to document extended ground segment requirements

PRD I: September 2003

- include
  - other NOAA, and some Federal Agencies user requirements
  - Product Processing requirements
  - potential Pre-Planned Product Improvement (P^3I) requirements
  - direct service and data and product distribution requirements
  - high-level Archive and User Interface requirements
- refine system requirements based on results of additional trade and cost benefit analyses
- use to govern further design studies

- use for final system requirements validation

PRD II: April 2005

- provides final validated set of comprehensive system requirements
- refines system requirements based on results of additional trade and cost benefit analyses.
- use to govern system GOES R procurement activities

This series of requirements documents is consistent with NOAA Administrative Order 208-3, Major Systems Acquisitions, for defining and managing mission and program requirements.

These documents will also be used to interface to and incorporate the GOES-R series requirements into the Dynamic Object Oriented Requirements System (DOORS). DOORS will be used for individual requirements allocation to subsystems, traceability, and linkage to higher level and generation of lower level documentation and other components of the Requirements, Planning and Budget, and Acquisition processes of the GOES-R program and the overall NESDIS satellite requirements process.

1.2 MISSION NEED

The U.S. Government (USG), Department of Commerce's (DOC) NOAA has as its primary environmental mission to provide forecasts and warnings for the United States, its territories, adjacent waters and ocean area, for the protection of life and property and the enhancement of the national economy. This mission requires an enduring capability to acquire, process and disseminate to central processing centers and distributed direct users, environmental data on an extensive spatial range (global, regional and local) within a variety of time scales (minutes to days). These data include, but are not limited to: global imagery; cloud and precipitation parameters; atmospheric profiles of temperature, moisture, wind, aerosols and ozone; surface conditions concerning ice, snow and vegetation; ocean parameters of sea temperature, color and state; solar and in-situ space environment conditions. These data are critically needed for: 1) severe storm and flood warnings; 2) tropical cyclone (hurricane reconnaissance and warnings); 3) hydrologic forecasts; 4) forecasts of the ocean surface and internal structures; 5) medium range forecast outlook (out to fifteen days); 6) solar and space environmental forecasts; 7) aviation forecasts (domestic, military, and international); 8) forecasts of ice conditions; 9) seasonal and inter-annual climate forecasts; 10) decadal-scale monitoring of climate variability; 11) assessment of long-term global environmental change; 12) environmental air quality monitoring and emergency response; 13) detection and analysis of fires and volcanic eruptions; and 14) short-term and mesoscale forecasts.

NOAA's extensive environmental observations requirements are addressed by a complementary system of space-, air-, land- and ocean-based systems consisting of remote and in-situ sensors. No one platform or sensor can begin to meet the diverse observational needs to accomplish NOAA's mission. The current observational systems include environmental satellites, radars, buoys, radiosondes, Automated Surface Observations System (ASOS), observations from aircraft (ACARS), upper air profilers, and Cooperative Observing Network and Climate Reference Network (CRN), etc. NOAA/NESDIS is the primary line office within NOAA for the program management of the operational environmental satellites systems, the geostationary or GOES, and the polar-orbiting or POES, programs. The polar-orbiting satellite system provides extensive global coverage of many environmental observations, on the order of several times a day, required for global modeling and climate prediction. In parallel the geostationary satellite system provides complementary hemispheric coverage, on the order of hours to minutes, for short-term forecasts

and warnings. The GOES satellites are a mainstay of weather forecasting for the United States and the other countries of the Western Hemisphere and are the backbone of short-term forecasting or nowcasting. Data and products from the geostationary instruments are also used within a number of regional models. These products include, but are not limited to, radiances over the water, layered precipitable water, derived motion winds and cloud-top information. Together these two operational environmental satellite systems are critical to meet NOAA's environmental observational requirements. The real-time weather data gathered by GOES satellites, combined with data from Doppler radars and automated surface observing systems, greatly aid weather forecasters in providing warnings of thunderstorms, winter storms, flash floods, hurricanes, and other severe weather. These warnings help to save lives and preserve property.

The first operational spin-stabilized GOES satellite was launched in 1975 carrying a visible and infrared radiometer which provided a wealth of imagery data that expanded our understanding of the atmosphere and improved forecasting on all scales. While instrumentation improvements in 1980 demonstrated the potential for atmospheric sounding from geostationary orbit, the spin-stabilized satellites could not provide simultaneous imaging and sounding. The GOES-I/M series began in April 1994, providing independent imaging and sounding capabilities from three axis-stabilized satellites. The last satellite in this series, GOES-M, was launched in July 2001. The follow-on satellites, the GOES-N series, are scheduled to begin in 2004. Primary sensors for the GOES-N series remain essentially the same as for the GOES-I series and the spacecraft will have additional space, power and data capacity for experimental sensors. One of the main improvements in the GOES-N series is the much smaller data outages due to the eclipse (periods of no direct solar power) and "Keep-Out-Zones" (periods of too much direct solar power). It is expected the GOES-N series will continue the mission of geostationary satellites into the next decade.

To meet requirements and accomplish their mission, the geostationary satellites perform three major functions:

- **Environmental Sensing:** Acquisition, processing and dissemination of atmospheric imaging and sounding data, along with solar and space environment (in-situ) data.
- **Data Collection:** Interrogation and receipt of data from earth surface-based data collection platforms and relay to the NOAA command and data acquisition stations
- **Data Broadcast:** Continuous relay of meteorological data to small, distributed users, independent of other system functions and relay of distress signals from aircraft or marine vessels to search and rescue ground stations.

In the next generation timeframe the space-based environmental observations addressed by the polar-orbiting system are documented in the National Polar-orbiting Operational Environmental Satellite System's (NPOESS), a joint Department of Defense (DoD) and DOC program, Integrated Operational Requirements Document Version II (IORD II). The space-based environmental observations to be addressed by the geostationary system in this time period are provided in this version of the GOES-R Operational Requirements Document Version I (PRD I).

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2 EXISTING AND PROPOSED SYSTEMS

2.1 BACKGROUND

The GOES-R series era requirements for climatic, synoptic and mesoscale imaging and sounding data to support global forecasts and local warnings have evolved from the requirements of the current GOES-I/M and planned GOES-N series of satellites. The National Weather Service (NWS) top priority requirements for the GOES-R series are for continuous, multi-spatial scale imagery data availability with improvements in temporal and spatial resolutions of the imagery and sounding data. In addition, they require full coverage of weather events, i.e., the ability to obtain soundings through clouds where the current infrared capabilities are limited, and information on instantaneous rainfall rates. Lightning and low-light data are also required to aid forecasters in potential convection analyses and to discern fog and storm outflow boundaries, respectively [*Operational Requirements Document*]. The ocean and hazard support communities require higher-resolution imagery data to meet NOAA requirements for observations of coastal zone, hydrological phenomena, and certain atmospheric processes. In addition, improvements are required in the areas of solar and space environment sensing, data collection and data broadcast. Each of these requirements advances primarily concern the space segment of the GOES program.

Historically the ground segments associated with the geostationary satellites required to perform the data and product processing, distribution, archive and user assimilation functions have been addressed independently. Unlike the space segment, these ground segments are not GOES-unique—they are components of larger operational systems within NOAA. However, to effectively and efficiently meet the GOES-R series requirements initially set by the users of this data, a complete end-to-end approach must be implemented. New and/or upgraded capabilities required for enhanced GOES-R series functions in the areas of product processing, distribution networks, and archive facilities must be identified, planned and budgeted for, and implemented. More formal interfaces with the users, in terms of sharing resources to insure the research, training, access, assimilation and application of these data is optimized, are also required. Only with this end-to-end systems approach can we attempt to meet requirements, exploit the full potential of these data, and validate program costs and mission need.

Replacement geostationary satellites are required to sustain capabilities beyond 2012. Lifetime probability predictions for the current and future space segments of the GOES-I and GOES-N series only support mission requirements through 2012. The follow-on GOES-R series is needed to provide mission continuity during the 2012-2025 era.

2.2 DATA CONTINUITY

2.2.1 During Eclipse Periods

Eclipse is the time when where is no solar light illuminating the solar panels and hence no spacecraft power is available. The viewing geometry of the current and planned geostationary satellites results in sunlight impingement on the optical path of the sensing instruments for several hours each day during the weeks around each equinox (eclipse). The stray sunlight may cause a degradation of the radiometric response accuracy of the earth-viewing detectors and potential permanent damage. To avoid damage, data are not sensed nor provided during these periods – termed the "keep-out zones." The combined impact on the current GOES-I series is a three to four hour loss of data for 10 to 12 days before and after each eclipse (around the spring and fall equinox). This is a significant loss of data for NWS, impacting critical forecasting and modeling

operations. The spring eclipse and keep-out zone period coincides with the tornado season while the fall eclipse and keep-out zone period coincides with the Atlantic Hurricane season [*Operational Requirements Document*]. The instruments on GOES-R should be designed in such a way as to minimize sunlight intrusion (and thus any possible damage). This will eliminate the need for "keep-out" zones with resulting loss of data. These restrictions do not pertain to the solar pointing space environment instruments or the magnetometer and some of the energetic particle detectors.

2.2.2 After Spacecraft Maneuvers

Periodic spacecraft maneuvers are required to adjust the drift and orbit of the geostationary satellites and to counteract the gravitational forces from the sun and the moon. The time needed for the current GOES-I/M satellites and the planned GOES-N series to return to normal operations after such maneuvers may be up to nine hours. This excessive delay is unacceptable for forecast and modeling operations that require and depend upon satellite data input. Improvements for the GOES-R series should include minimizing the disruption to data to less than one hour after spacecraft maneuvers. Maneuvers should also be scheduled to minimize data continuity gaps during NWS Critical Weather Events [*Operational Requirements Document*].

2.3 PERFORMANCE AROUND LOCAL MIDNIGHT

Many performance specifications for the GOES-I/M and GOES-N series were relaxed around local midnight, usually for a period of four hours. However, severe thunderstorms, tornadoes, and flash floods often occur around local midnight; sometimes they develop, intensify, and move over data sparse regions. Additionally, satellite-derived winds are required for forecast operations during these hours and in the GOES-R series era will be required on an hourly basis. For the GOES-R series performance around local midnight should meet daylight performance [*Operational Requirements Document*].

2.4 CAPABILITY GROWTH

Having the capability to fly prototype sensors on the GOES operational satellites, to support atmospheric research and development activities, is key to full exploitation of data and products (i.e., weather forecasting, oceans and climate). For the GOES-R series, candidate prototype capabilities such as all-weather (microwave) sounding, low light imaging, high resolution imaging and additional solar and space sensing are indicated.

2.5 IMAGERY SENSING

2.5.1 Geographic Coverage

The ability to interleave hemispheric (Full Disk), synoptic (Contiguous United States (CONUS) Regional) and mesoscale (Rapid-Scan) imaging is required for GOES-R. The current and planned systems are incapable of providing southern hemisphere images during Rapid-Scan operations (invoked to support severe weather outbreaks) and cannot meet the temporal requirements for Full Disk, CONUS updates, and southern Hemispheric users. Imaging and derived high-density wind products below the equator are required during mesoscale imaging. The current lack of these winds significantly degrades performance of global forecast models. Uninterrupted southern hemispheric observations are advantageous to cloud motion analyses for numerical weather prediction, and for monitoring of volcanoes and synoptic-scale weather systems affecting U.S.

aviation, marine and military operations and are necessary for all users in the Southern Hemisphere. [*Operational Requirements Document*].

2.5.2 Spectral Coverage

The current imagery spectral sensing cannot meet requirements for all operational data and derived products in the GOES-R series era. While these visible, long- and short-wave IR window, and the IR water vapor (300-500 hPa) bands are essential tools for forecast operations at present-day NWS forecast offices and National Centers, additional sensing capabilities are needed to meet all future NWS cloud, moisture and surface observation requirements. Additional sensing/detection capabilities needed include those for:

- New or improved daytime cloud/snow/ice discrimination; total cloud cover; aviation weather analyses for icing; smoke from low-burn-rate fires.
- New or improved tropospheric water vapor tracking; tropospheric flow tropical storm track prediction weather; winter storm analyses.
- Continuous day/night cloud analyses for many general forecasting applications; precipitation estimates; severe weather analyses and prediction; cloud drift winds; hurricane strength and track analyses; cloud top heights; volcanic ash; fog (in multi-band products); winter storms; cloud phase/particle size (in multi-band products).
- Continuous cloud monitoring for numerous applications; low-level moisture; volcanic ash trajectories; cloud particle size (in multi-band products).
- Determining vegetation amount, aerosols and for ocean/land studies.
- Characterizing aerosols and their optical properties is essential for improving a number of satellite products, for example Sea Surface Temperature (SST), ocean color and surface temperatures. This band also enables very localized vegetation stress monitoring, fire danger monitoring, and albedo retrieval.
- Daytime sensitivity to very thin cirrus. This will aid several products relying on clear skies in the infrared windows, for example SST.
- Detection of volcanic cloud with sulfuric acid aerosols, thin cirrus and the determination of cloud microphysical properties (in conjunction with other bands). A more accurate delineation of ice from water clouds during the day or night.
- Determination of microphysical properties of clouds (in conjunction with other bands). A more accurate determination of cloud particle size during the day or night.
- Dynamics of the atmosphere near the tropopause, power and structure in upper air mesoscale storms, upper-tropospheric wave patterns.
- Detection of haze, aviation slant range visibility, air pollution, color imagery.

2.5.3 Temporal Resolution

The current data refresh rate of the imagery data is for a Full Disk image every 3 hours and a CONUS image every 15 minutes. In the GOES-R era, Full Disk imagery is needed every 15 minutes and CONUS imagery every 5 minutes. For severe weather activity, updated satellite imagery data every 30 seconds covering more than a 1000 x 1000 km area is also needed. These improvements allow synoptic scale changes to be monitored and satellite-derived wind production over the southern hemisphere, resulting in improved regional and global model performance. They also allow the monitoring of rapidly changing mesoscale events, which could increase the lead-time for watches and warnings in CONUS and adjacent waters by up to 50% in areas with insufficient radar coverage [*Operational Requirements Document*].

2.5.4 Spatial Resolution

The current GOES-I and planned GOES-N series resolution of GOES imagery data in the visible band is 1 km. In the GOES-R era visible imagery data are needed at an improved spatial resolution of at least 0.5 km. This upgrade will improve forecasters' ability to identify severe thunderstorms, possibly resulting in improved warning lead times, especially in areas with limited radar coverage. This upgrade will also improve forecasters' ability to make quantitative precipitation estimates (QPE) and quantitative precipitation forecasts (QPF) [*Operational Requirements Document*].

This improved spatial resolution will reduce cloud image smearing by encoding definition of cloud edges: 1) for better image interpretation (e.g., severe weather forecasting); 2) for improved target selection for cloud drift wind measurements and stereo cloud height determination; and 3) for optimization of cloud clearing techniques for derived products (e.g., SSTs and stability) [*Operational Requirements Document*].

The current spatial resolution of GOES imagery data for the IR bands is 4 to 8 km. GOES-R era infrared imagery data is needed at a spatial resolution of 2 km for all bands. A common spatial resolution for all IR bands is required to support generation of multi-channel products. This will improve nighttime detection of severe thunderstorm signatures possibly resulting in improved warning lead time (10%) and detection of fog at night resulting in improved aviation, public, and marine forecasts. In addition this will allow improved detection of cloud top temperature gradients resulting in improved QPEs/QPFs [*Operational Requirements Document*].

Because forecasters must infer information from the IR bands at night, similar to that which is inferred from the visible band during the day, the objective is for the IR band spatial resolution to be the same as the visible band resolution [*Operational Requirements Document*].

2.5.5 Data Earth Location

The current earth location accuracy for GOES imagery data is 6 km. This is not sufficient to allow forecasters to accurately locate cloud features and phenomena and allow the data to be merged with other data sources, resulting in improved forecasts and warnings (public, aviation, and marine) [*Operational Requirements Document*]. In the GOES-R series era the earth location accuracy needed is 0.5 km at the sub-satellite point.

2.6 SOUNDING SENSING

2.6.1 Spatial Resolution

To match the model resolutions in the GOES-R series era the spatial resolution of the soundings need to improve to a minimum of 10 km with an objective of 2 km. This resolution is needed to allow for the monitoring of the precursors of severe weather. This resolution of soundings is needed to define the temperature and moisture gradients between other conventional ground-based data platforms.

2.6.2 Geographic Coverage

To allow for accurate generation of cloud products hourly over the CONUS, plus oceanic coverage, for assimilation into numerical models the spatial area of the sounding sensing should improve in the GOES-R series era. Within each hour, temperature and moisture soundings over an area of 12,000 x 12,000 km (vs 3,000 x 3,000 km for GOES-I/M and N Series) are needed.

2.6.3 Product Accuracies/Vertical Resolution

Soundings from geostationary orbits are needed by NWS operations because of their continuous spatial and temporal measurements of temperature, moisture and wind. Many of the Western Hemisphere countries have also expressed a strong desire for better access to the sounding data. The current accuracies for GOES temperature and moisture soundings are 2 degrees Centigrade (^{o}C) per 3 to 5 km layer and ± 20%, respectively. However in certain meteorological situations this can equate to a 10 ^{o}C temperature error. This is due to the limited vertical resolution of the current sounding instrumentation to measure these highly variable parameters throughout the atmosphere. The availability of high vertical resolution, together with high temporal resolution, soundings would greatly enhance NWS's ability to initialize models with more realistic observations of temperature, moisture and wind. For the global and synoptic scale models, these soundings would fill large spatial gaps from the comparably accurate radiosonde network out over the coastal oceans and in the southern hemisphere. For the mesoscale models, these accurate soundings, available each hour, would enable numerical models and forecasters to better identify areas of rapidly developing atmospheric instability responsible for vertical motion, convection, and precipitation development. In the GOES-R series era a significant improvement in the vertical resolution of the sounding capability is needed.

2.6.4 Data Earth Location

The earth location accuracy of the sounding data in the GOES-R series era must improve to 2.5 km in both normal and rapid scan modes. This allows for more accurately earth-located data to be merged with other data sources, resulting in improved forecasts and warnings (public, aviation, and marine) [*Operational Requirements Document*].

2.7 SOLAR SENSING

The established requirements for observations of disk-integrated solar x-ray flux, disk integrated extreme ultraviolet (EUV) flux, and solar X-ray imaging are similar to those set for the existing GOES-N series of satellites. Meeting the additional requirement for coronagraph observations of the outer solar corona will improve forecasting of geomagnetic storms. This section provides the requirements and benefits for the solar Space Environment Monitor (SEM) instruments for GOES-R series including changes from (and to meet specifications that were requested but not met) the GOES-N series. All of these improvements are important for data products that support systems and human activity affected by conditions in the space environment.

2.7.1 Solar X-Ray Imaging

Requirements for GOES-R Solar X-ray Imaging (SXI) dynamic range have been extended beyond those for GOES-M and GOES-N/O to enable simultaneous (within one minute) flare patrol for short-term radiation storm forecasts and coronal hole location and active region imaging to support mid-term forecasts of geo-effective events. The resulting spacecraft data will be more uniform and thus provide a much better basis for input to automated analysis and models. Full dynamic range effective temperature maps will be available as often as every three minutes, which will also greatly simplify instrument operations and ground data processing because fewer exposure types are required.

In addition, doubling the sensitivity so that useful signal-to-noise ratios can be obtained from extended corona and coronal holes will allow for improved detection of coronal holes. Imaging the

extended corona will enable more definitive detection of Coronal Mass Ejection (CME) signatures such as coronal dimmings and waves.

Expanding the GOES-N series solar imaging temperature range for the GOES-R series will improve the ability to distinguish coronal features by temperature, including flares and the lower corona, in a timely fashion.

Improving the spatial sampling over the GOES-N series SXI capabilities will allow the true optical performance to be realized. Increasing the GOES-R series solar imaging spatial resolution will improve the ability to distinguish solar features with potential geo-space impacts. Greater resolution provides the ability to accurately resolve the boundaries of coronal holes and active regions and is sufficient to roughly image flares with length scales of ~10,000 km.

2.7.2 Solar X-Ray Sensing

Minor modifications from the GOES-N series are recommended. These include improvements of the threshold levels and the flux resolution. The reduction of the threshold will allow for better monitoring of Long Duration Events (LDE) during times of minimal solar activity. The enhanced flux resolution will provide better quality data.

2.7.3 Solar Extreme Ultraviolet Sensing

For the GOES-R series, additional bands are needed to both extend the EUV measurements to shorter wavelengths and to fill in gaps in the wavelength coverage. This will improve the ability to obtain improved height resolution for thermospheric heating rates and ionization rates, and to monitor solar EUV flares.

The objective temporal resolution requirement for GOES-R has been increased. Ten-second temporal resolution has been determined to be optimum for observing EUV flares and fast changing EUV flux levels. The solar EUV flux can change by 50% in a few minutes. Sample rates longer than 10 seconds do not allow for quick response to rapidly changing events.

A new requirement for real-time transfer of the EUV data has been added for the GOES-R series to allow the EUV instrument to be used in the early prediction of solar flare magnitude and the improved estimation of solar energetic proton probabilities.

2.7.4 Solar Corona Sensing

Coronagraphs to observe coronal mass ejections are not included in current GOES spacecraft. However, the utility of these observations for space weather forecasting have been demonstrated through the combined use of EUV imaging and white light coronagraph data from the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA) Solar and Heliospheric Observatory (SOHO). The GOES-R series coronagraph will significantly improve lead times in forecasting geomagnetic storms. Coupled with images from the Solar X-Ray Imager, multi-day forecasts of geomagnetic storms will be possible. The coronagraph will be used to determine whether a Coronal Mass Ejection (CME) has occurred, whether it is likely to impact earth, and when it will impact. Coronagraph observations will also be used as an aid in predicting the intensity and duration of CME produced geomagnetic storms. CMEs are one of the two known causes of geomagnetic storms. Thus, the overall solar imaging requirements for the GOES-R series now include this enhancement with the requirement to determine the occurrence, speed, direction, and spatial extent of coronal mass ejections.

2.8 SPACE ENVIRONMENT MEASUREMENTS

2.8.1 Energetic Particles Measurements

Enhancements to the capability of the GOES-R series to sense energetic particles include expanding the energy range of electrons and protons to lower energies, and adding measurements of energetic heavy ions. The expansion of the energy coverage to lower energies will provide operational information on the plasma environment that causes surface charging in spacecraft. NOAA, NASA, DoD, other national and international agencies, and the commercial satellites industry will use these measurements extensively. The real-time operational measurements will be critical for the analysis of satellite and sub-system failures (assessing the cause of anomalous behavior in spacecraft systems), for spacecraft design and post-event analyses relating to satellite and sub-system failures, for human radiation risk assessment.

2.8.2 Magnetometer

The magnetometer requirements are essentially unchanged from what has been flown on previous GOES systems. However, the 8 Hertz (Hz) refresh rate threshold is greater than the 2 Hz refresh rate objective that has previously flown. The increased rate will provide the opportunity to measure waves in geosynchronous orbit that are important for exchanging energy with the geosynchronous particle environment. These measurements are important for understanding processes that control the particle environment that cause anomalous behavior in spacecraft systems.

2.9 DATA BROADCAST

2.9.1 Raw Sensor Data

The raw sensor downlink requirement for the GOES-R series of spacecraft will be significantly different from the corresponding GOES-N series downlink in order to support the new imagery and sounding capabilities expected to be provided by this series of spacecraft. At this time, the data rate needed for the sounding data is the primary factor in determining the overall performance factors for this link.

2.9.2 Sensor Data Rebroadcast

Due to the increased volume of data expected from the GOES-R series enhanced imagery and sounding requirements, rebroadcast of the full set of those data cannot be accomplished with the current GOES system. The GOES-R system must have the capability to rebroadcast the required data.

2.10 DIRECT SERVICES

2.10.1 LRIT Broadcast

NESDIS currently uses Weather Facsimile (WEFAX), an analog meteorological broadcast service, to disseminate GOES, POES and foreign satellite meteorological data to users using the GOES L-band down-link frequency. However, in response to the World Meteorological Organization's (WMO) recommendations for digital meteorological satellite broadcasts, the follow-on series, GOES NOPQ, will replace WEFAX with a new digital service called Low Rate Information

Transmission (LRIT). An earlier transition to LRIT on the existing GOES I-M series was also considered by this study. The transition from the (analog) WEFAX format to the digital LRIT format will require modification to the Central Environmental Satellite Computer System (CEMSCS). The CEMSCS currently ingests the retransmitted GVAR data streams through a Front End Processor (FEP) and provides inputs for applications that generate the WEFAX products. The LRIT service will be supported by the GOES-R series as well.

Since the transmission formats of WEFAX and LRIT are incompatible, the current WEFAX customers will need to upgrade or replace their existing WEFAX stations to receive the new LRIT products. The development of relatively inexpensive ground stations for receiving LRIT transmissions is a major goal of the WEFAX-LRIT transition. The LRIT datastream is designed to contain not only digital images and sounder output but also a rich suite of other products including *in situ* observations, forecasts, analyses, and numeric model output.

2.10.2 EMWIN

The Emergency Manager's Weather Information Network (EMWIN) is required to provide Local Emergency Managers and the Federal Emergency Management Agency (FEMA) with a relatively inexpensive and portable lightweight method of receiving GOES digital data for their operational needs. The EMWIN signal was first used on the GOES-I/M series of spacecraft but shared a transponder with the Weather Facsimile transmissions. Beginning with the GOES-N spacecraft, the EMWIN signal was moved to a separate transponder and other modifications were implemented to minimize the impact of power reduction. Other enhancements are not yet set for the GOES-N series spacecraft.

2.10.3 Search and Rescue

The Search and Rescue (SAR) subsystem onboard the GOES satellite is a dedicated transponder that detects 406 MHz distress signals transmitted by Emergency Locator Transmitters (ELT) carried on aircraft, Emergency Position-Indicating Radio Beacons (EPIRB) aboard marine vessels, and Personal Locator Beacons (PLB) used in land-based applications. The distress signals are relayed by the GOES satellite to a ground station located within the field of view of the satellite. The information is then passed to a mission control center and ultimately to a rescue coordination center from where help is dispatched.

The GOES SAR subsystem is part of the U.S. Search and Rescue Satellite-Aided Tracking (SARSAT) Program, and the international Cosmitscheskaja Sistema Poiska Awarinitsch Sudow - SARSAT (COSPAS-SARSAT) Program. As part of the international COSPAS-SARSAT Program, the United States and other countries operate satellites with SAR payloads in low-earth and geostationary orbits. The system has contributed to the rescue of over 11,000 people.

The Department of Commerce requires the GOES-R program to be operationally compatible with and to carry specific receivers, transmitters, etc., necessary to fulfill DOC's international agreements (Russia, Canada, United States, and France. COSPAS-SARSAT agreement, 1 Jul 1988, as amended) for search and rescue (i.e., determine emergency transmitter locations).

2.11 DATA COLLECTION

The GOES Data Collection System (DCS) collects near real-time environmental data from more than 19,000 data collection platforms located in remote areas where normal monitoring is not practical. The DCS receives data from platforms on ships, aircraft, balloons and fixed sites. These

data are used to monitor seismic events, volcanoes, tsunami, snow conditions, rivers, lakes, reservoirs, ice cover, ocean data, forest fire control, ground-based magnetometer data, meteorological and upper air parameters.

Over 200 river and rain gauges are under each NWS radar umbrella to provide complementary data for use in their forecast and warning system.

2.12 COMMAND, CONTROL AND COMMUNICATIONS

The GOES-N-Q ground system generates the spacecraft commands for uplink; processes the command and control telemetry downlinks, Imager and Sounder instrument data downlinks, and the MDL (Multi-use Data Link) data downlink; generates the GVAR (GOES Variable) data uplink to the spacecraft; determines the spacecraft orbit and attitude using star look, range, and landmark data; and monitors the quality of the GVAR data broadcast by the GOES spacecraft.

The equipment resides at NOAA facilities in the SOCC (Satellite Operations Control Center) in Suitland, Maryland, at the Wallops CDAS (Command and Data Acquisition Station) in Wallops, Virginia, and at the Wallops Backup CDAS (WBU) hosted at the Goddard Space Flight Center in Greenbelt, Maryland. The CDASs provide the RF (Radio Frequency) transmit and receive interface with the spacecraft for all functions. Both CDASs used for GOES-N-Q offer similar capabilities, but the Backup CDAS can support only one spacecraft. The SOCC is capable of receiving only the GVAR and MDL signals. Primary GOES command, control, scheduling, and engineering operations activities are hosted in the SOCC, but complete backup capabilities are maintained at the CDASs. In addition to the capabilities hosted at the SOCC and CDASs, the MDL Receive System and Server (MRS&S) will be installed at the SEC in Boulder, Colorado, to provide SXI instrument data receipt and service as well as the other SEM data.

GOES-R changes to the ground system will be centered on the increased amount and accuracy of the sensor data. There will be an increased automation of routine daily operations—schedule generation and scheduler processes. The uplink rate will be increased to support large memory capacity instruments and spacecraft autonomous or minimal manual operations for nominal daily operations. The current system allows a single log in to command multiple spacecraft. The GOES-I/M system required a log in to a specific spacecraft, which is better in that it provides positive isolation from spacecraft to spacecraft to reduce confusion and ensure commands are not sent to the wrong spacecraft. The ground system should include a self-monitoring function that allows it to verify that data are flowing (command / telemetry and all mission data) and to autonomously take action to reconfigure to correct the outage. It should also provide a tracking log of its activities and have pre-determined alternative configurations.

2.13 PRODUCT GENERATION AND DISTRIBUTION

2.13.1 Product Systems and Distribution Networks

The GOES product systems are but one component of the NESDIS operational product generation and distribution system. All product systems used to process the GOES-N series data will need to be thoroughly reviewed for modifications or new developments required in the GOES-R series era to handle the substantial changes expected for the imagery and sounding capabilities. Modifications in areas such as data access, calibration, product generation, quality control, and product distribution will be needed. Upgrades are envisioned to concentrate in the areas of enhanced system and distribution network capabilities to handle the increased volume of data and in science support to meet product type and accuracy requirements and to optimize the processing

and usefulness of the enhanced data. We must assess our requirements in these areas and incorporate these changes into the full NESDIS operational product generation and distribution system requirements for appropriate planning and development.

2.13.2 Data Latency

Product delivery (timeliness) must be done in real time to capture rapidly changing, relatively short-term events, (e.g., severe weather, thunderstorms, and flash floods). The usefulness (forecast value) of the current GOES imagery is greatly diminished if the images are not available for analysis by the forecaster before the start of the next image (i.e., in near real-time). Timely delivery of data allows for more timely and accurate warnings and forecasts [*Operational Requirements Document*]. In the GOES-R series era, product timeliness needs to be increased to meet user requirements. Modifications required to meet these needs must be assessed and incorporated into the full NESDIS operational product generation and distribution system requirements for appropriate planning and development.

2.14 ARCHIVE

In the GOES-R series era an upgraded Comprehensive Large Array-data Stewardship System (CLASS), or its follow-on, will be in place to handle the extensive types and volumes of environmental data required to be archived and accessed. This system is a re-engineering and upgrading of current archive capabilities of the National Data Centers [National Climatic Data Center (NCDC), National Geophysical Data Center (NGDC), National Oceanographic Data Center (NODC)]. Data which are currently archived include National Weather Service (NWS) Next Generation Weather Radar (NEXRAD), Cooperative Observer Program (COOP), Automated Surface Observations System (ASOS), rocket and Radiosonde & Radar Wind Sounding (RAWINSONDE), climatic and model data; National Ocean Service (NOS) hydrographic data, and bathymetric and topographic maps; National Marine Fisheries Service (NMFS) data; NOAA Research (NOAA OAR) solar radiation, aircraft reports and wind profiler and geologic data; National Environmental Satellite, Data, and Information Service (NESDIS) Polar-orbiting Operational Environmental Satellite (POES) and GOES data; and DoD Defense Meteorological Satellite Program (DMSP) data. This volume of data in 2000 was 1,00 TB annually. However with the added requirements for archiving and providing access to NASA Earth Observing System (EOS), National Polar-orbiting Operational Environmental Satellite System (NPOESS) NPOESS Preparatory Program (NPP), European Space Agency's (ESA) Meteorological Operational Satellite (MetOp) and full NPOESS data in the 2005-2010 timeframe this volume will increase to over 13,000 TB of data annually.

The CLASS system is being developed to accommodate this significant increase in data while allowing for more integrated and efficient capabilities among the data centers. As such, the CLASS program maintains its own requirements documents of which the GOES portions will need to be included for the GOES-N series and updated for the GOES-R series.

With the significant increase in data expected from the GOES-R series satellites from the enhanced imaging and sounding capabilities, Levels 1 and 2+ data and product dataset archive requirements must be clearly defined. These requirements need to be incorporated into the development and implementation of the CLASS, or its follow-on system, and the planned communication networks.

2.15 USER INTERFACE

To fully optimize the data, as required initially by NOAA users, and also to be used by other US and foreign agencies, a more formal coordinated program is needed to address the areas of user access to, training for and optimization of the application of this enhanced data. This needs to be a shared program between the GOES program and the users to begin at this planning and requirements phase and carried through the GOES-R series lifetime. This is needed to insure the intent of the initial requirements is carried throughout program development and design phases; to allow for appropriate user planning of upgrades to address the timing (availability), format, volume, processing and further distribution, etc. of these data; to allow interface with early simulation datasets to enhance user readiness and reduce post launch transition periods to reach operational capability; to develop joint programs for science research to support required to optimize customer use of this data; and to develop joint training programs for the application of this data.

2.16 NEEDS TO REQUIREMENTS

The fundamental needs identified above are further defined as program requirements in Section 3 and associated appendices. The table below maps these needs to corresponding section 3 paragraphs.

Needs		Program Requirements Sections
2.2	Data Continuity	3.2.3, 3.2.3.1, 3.2.3.2
2.3	Performance Around Local Midnight	3.2.5
2.4	Capability Growth	3.2.6, 3.5
2.5	Imagery Sensing	3.2.4, 3.2.4.1, 3.2.4.2, 3.4, 3.4.2
2.6	Sounding Sensing	3.4, 3.4.2
2.7	Solar Sensing	3.4.14-16
2.8	Space Environment Measurements	3.4.14, 3.4.15
2.9	Data Broadcast	3.3.8.1, 3.3.8.2, 3.7.5
2.10	Direct Services	3.3.8.3, 3.3.8.4, 3.3.8.7, 3.7.1, 3.7.2, 3.7.3
2.11	Data Collection	3.3.8.5. 3.3.8.6, 3.7.4
2.12	Command, Control and Communications	3.3
2.13	Product Generation and Distribution	3.4.1, 3.6
2.14	Archive	3.8
2.15	User Interface	3.9

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3 PROGRAM REQUIREMENTS

The following program requirements in this document are organized along these architectural lines. In some instances these requirements are identified in terms of "threshold" and "objective," with the following meaning:

- ***Threshold*** - The minimum acceptable requirement. All requirements expressed in this document are threshold unless stated as an objective.
- ***Objective*** - A requirement that if met, would greatly enhance the utility of the system.
- ***** - Requirement also carried in P^3I section for further study.

3.1 GENERAL SYSTEM REQUIREMENTS

3.1.1 System Need Date

The ends of GOES-O and GOES-P's operational lives drive the GOES-R system need date. The operational life for GOES-O is expected to end in 2013 and the operational life for GOES-P is expected to end in 2018. Because the GOES-R constellation is being integrated into an existing system over time, GOES-R systems requirements must be defined in terms of Initial Operating Capability (IOC) and Full Operational Capability (FOC). IOC measures characterize the system during integration, while FOC measures characterize the system after integration is complete.

3.1.1.1 INITIAL OPERATIONAL CAPABILITY

GOES-R must be capable of achieving IOC by the end of GOES O's operational life and maintaining this operational capability up to FOC. IOC is defined as meeting either of the west or east zone system availability requirement plus the central zone system availability requirement (see 3.2.2) exclusively with GOES-R series satellites and associated Command, Control and Communications (C^3), Product Generation and Distribution (PGD), archive and user interface.

3.1.1.2 FULL OPERATIONAL CAPABILITY

GOES-R needs to be capable of achieving FOC by the end of GOES-P's operational life. FOC is defined as meeting the system availability requirements for all coverage zones (see 3.2.2) exclusively with GOES-R series satellites and associated C^3, PGD, archive and user interface.

3.1.2 Information Security

Information security is a combination of administrative policies and procedures for identifying, controlling, and protecting information from unauthorized disclosure. GOES-R series information security shall comply with applicable DOC directives.

3.1.3 Human Factors

Human factors engineering shall be applied during development of GOES-R series to achieve effective human-system interfaces and minimize or eliminate system characteristics that require: extensive cognitive, sensory, or physical skills; overly intensive training, excessive workload; reduced situations awareness; or result in frequent or critical errors. Where manual operation is necessary to achieve system performance requirements, human performance time and accuracy will be included in the determination of whether or not those system requirements have been met.

Human factors engineering will comply with all requirements of the Occupational Safety and Health Administration (OSHA) and other Federal laws. Constraints peculiar to the GOES-R series ground equipment are TBD.

3.1.4 Training Concept and Objectives

The requirement for GOES-R series C3, PGD, Archive and User Interface Segment training is for operations and maintenance personnel to be certified as qualified to operate the hardware and software of these GOES-R series segments. Qualification will be certified by the contractor training instructors following execution of a training plan subject to USG approval. The training plan to meet this objective will cover all aspects of hardware and software needed to insure operational continuity of the GOES-R series data acquisition, data quality control, and derived product processing and distribution. All operations staff is required to be fully trained before the start of IOT&E.

A training plan shall be provided not later than 6 months prior to the scheduled delivery of the GOES-R series Ground Equipment. This training plan shall be consistent with the provisions of applicable agency standards. Software maintenance and usage training will be provided in accordance with applicable agency standards. Sufficient hardware (training simulator systems) shall be provided to ensure the system operators and maintainers can be trained to properly perform their mission. Upon completion of any contractor-developed course, copies of training materials (instructor lesson plans, student study guides, overheads, etc.) will be provided to the appropriate government agency for use in developing follow-on sustainment training.

3.1.5 General System Climate Requirements

The uniqueness of measurements from geostationary orbits is its capability in sampling the same location at frequent intervals of time (e.g. every 15 minutes) in comparison with the 12 hour sampling interval of satellites in polar orbits. However, satellites in polar orbits provide nearly global coverage in contrast to the regional or somewhat continental scale coverage provided by satellites in geosynchronous orbits. The frequency of the geostationary measurements provide the capability to observe sub-synoptic atmospheric and surface events, particularly precipitating cloud systems and to characterize the diurnal cycles of the surface and atmospheric boundary layer.

Characterization of the annual cycle and diurnal cycles is crucial to an understanding of climate and having better knowledge of the diurnal cycle improves the characterization of the annual cycle. This can be understood by imagining a situation where observations are taken at nearly the same time each day of the year, such as the case with a sun-synchronous polar orbiter. If the diurnal variation changes throughout the year, the annual cycle derived from the fixed-time observations would be fallacious. Averaging measurements from a number of polar orbiters will only reduce the error, but not eliminate it.

Climate forcing by the absorption of solar radiation takes place mostly at the surface and has a strong diurnal and seasonal cycle. The main source of energy for the atmosphere is the transfer of the solar heating from the surface through the atmospheric boundary layer and occurs through a series of rapid processes, which include convective heat and moisture transports, latent heat exchange of evaporation from the surface and precipitation, and radiative fluxes modulated by clouds. It is essential, therefore, to diagnose climate variations at space-time-scales characteristic of the forcing.

Before realistic requirements for making the appropriate measurements are defined, it is crucial to understand the nature and magnitude for monitoring and predicting climate change. Most climate signals change very little over a long-term span, but it is these changes that can have great consequences for a changing climate. For example, global temperature may change by only a few tenths of a degree per decade and be significant to a climate change. Similarly, ozone may change by 1% per decade or solar irradiance change by 0.1% per decade to have an impact. Therefore, it is imperative to design a measuring system capable of measuring these changes. However, regional climate change signals can be much greater, but they are still generally very small.

Cognizant of the unique problems in designing a system for observing climate change from satellites, a number of general requirements are listed.

3.1.5.1 ORBIT DRIFT

Orbit drift needs to be minimized. While this is obvious for polar satellites, it is also important for geostationary satellites, since a drift in the orbit would result in a shift in the angle of view for a given viewing region, a particular advantage of these satellites. By keeping the angle of view fixed, the observations of the region vary as the solar zenith angle varies over the day. Then, the diurnal distribution can be derived without having to correct for changes in the viewing angle.

3.1.5.2 SATELLITE OVERLAP

Sufficient overlap of satellites is essential. This is the backbone of long-term observations to maintain data stability and is essential for data continuity. When a new satellite is launched there must be a period where the data sets are compared and adjusted to maintain long-term continuity.

3.1.5.3 REPLACEMENT PRIOR TO FAILURE

To ensure sufficient overlap as stated above, satellites need to be replaced prior to instrument or satellite failure. This will probably be expensive, but it is highly desirable to accurately detect climate change. If this is not done, then it would be necessary to compare the data observed from the geostationary satellite with equivalent data obtained from a polar satellite. The polar satellite would act as a transfer to the data from the new geostationary satellite after it is launched. While this type of transfer between geostationary satellites is far from ideal, it would permit some degree of continuity although there would still be a gap in the data record.

3.1.5.4 PRE-LAUNCH CHARACTERIZATION

There needs to be a rigorous pre-launch characterization of instruments. Of particular importance is the accuracy, precision, and long-term stability and must include everything that could affect the measurement. Demonstrable calibration against absolute standards is fundamental to climate science. Quality calibrations will only be achieved if they are given highest priority in mission design. Radiances must be calibrated and cross-calibrated both between satellites in a particular series and among all geostationary satellites in operation.

3.1.5.5 ADEQUATE ON-BOARD CALIBRATION

The GOES observing location is well suited to determine the diurnal component of chaotic processes like clouds and precipitation, which play a large part in the earth's energy and water budget. Long-term trends and changes in the diurnal cycle can be measured reliably only by a consistently calibrated time-series of daily processes over decades. For climate use, GOES-R

instruments require radiometric calibration accuracy and precision that are comparable to the other satellite radiometers on operational and research satellites. The pre-launch and post-launch calibration procedures should facilitate cross-calibration among all the other satellites.

Adequate on-board calibration is required to make reliable measurements of climate parameters from GOES-R. This is not a one-time occurrence, but must be checked periodically. This is absolutely necessary for long-term climate observations. Both the thermal emission and solar reflected spectral data must be calibrated. In particular, the solar reflected channels contain important information about cloud and surface properties whose variations and trends must be reliable.

GOES-R calibration should provide accurate (±1 K and ±3%), precise (±0.1 K and ±1%) and diurnally stable (0.1K) measurements. The calibration accuracy and precision from the GOES-R radiometers should be sufficient to measure variations and changes in the earth's radiation and physical properties with an acuity that is sufficient to answer the important questions about climate change.

GOES-R calibration should be controlled and determined across the spectrum and over the field-of-regard, before and after launch. Instrumental effects that affect calibration as a function of wavelength and viewing angle should be minimized. For example, the sensitivity to polarized light from the earth should be minimized among the solar reflective bands. Pre-launch calibration should be traceable to standards. Post-launch calibrations should be validated periodically.

Calibration information should be included in the data archive process. Climate determinations are achieved by reprocessing archived radiometry. Therefore, calibration data and metadata must be part of the archive. For accuracy to be demonstrable in flight, redundant systems are essential.

3.1.5.6 LONG TERM AND ANOMALY TIME SERIES VARIANCE STABILITY

In addition to inclusion of long term stability values for each environmental observation required for climate applications, long term stability values for radiances from each associated instrument shall be included. Furthermore to avoid discontinuity in climate time series and major impacts to intercalibrating previous GOES and planned NPOESS instruments, significant changes in the infrared sensing spectrum of GOES R instruments from the noted instruments shall be minimized.

3.1.5.7 PRODUCT REPROCESSING

Reprocessing needs to be an operational priority of climate products to remove spurious trends. This may require the reprocessing to be performed a number of times.

Note: A National Academy of Science (NAS) study is currently underway to provide information NOAA will use to plan the production of climate records from operational satellites. The NAS project title is "Climate Data Records from Operational Satellites: Development of a NOAA Satellite Data Utilization Plan" under Project Identification Number: BASC-U-02-08-A. The project began in April, 2003, a series of meetings will be complete by October, 2003 followed by an interim report (near the end of CY03) and a final report (near the end of CY04). The project scope can be viewed at: http://www4.nas.edu/webcr.nsf/ProjectScopeDisplay/BASC-U-02-08-A?OpenDocument. PRD II will include applicable information and requirements for climate data processing that result from this project.

3.1.5.8 ACCESS TO PRODUCTS AND IN-SITU OBSERVATIONS

There should be ready access to products, metadata, and raw data, which is necessary for reprocessing and may be necessary for data rescue. Access to in situ baseline observations will permit blending research and operational products.

3.1.5.9 CONTINUATION OF OBSERVATIONS ON DECOMMISSIONED SATELLITES

Baseline instrument observations need to be continued on decommissioned satellites. When satellites have completed their operational use, it is important to continue operating an instrument from which a climate product is generated as long as it is still working. This will yield extended mission data.

3.1.5.10 MONITORING NETWORK PERFORMANCE

Real-time monitoring of network performance will help to identify errors early and facilitate reanalysis.

3.2 SPACE SEGMENT REQUIREMENTS

3.2.1 System Availability

System Availability is the probability that a system can be successfully used for any specified mission over a stated period of time. For a successful mission, the system must provide continuous collection, downlink and retransmission of acceptable imaging and sounding data products. All instruments and all auxiliary services and communications shall be operational at the time of first on-orbit operation.

3.2.1.1 COVERAGE ZONES

System Availability is expressed in terms of coverage zones. Coverage zones are specified as follows:

Zone	Imaging	Sounding
West	Latitude: From 68° to -68° Longitude: From -213° to –58°	Latitude: From 52° to -52° Longitude: From -105° to –187°
Central	Latitude: From 68° to –68° Longitude: From -182° to –28°	Latitude: From 52° to -52° Longitude: From -158° to -52°
East	Latitude: From 68° to –68° Longitude: From -153° to 3°	Latitude: From 52° to -52° Longitude: From -105° to -23°

3.2.1.2 NORMAL MODE

Under normal operating conditions, the availability of all priority 1 products over Threshold coverage areas shall be at least 99% (threshold) with an objective of 100%.

3.2.1.3 BACKUP MODE

In the event of an on-orbit instrument and/or spacecraft failure that would require reconfiguration of remaining on-orbit assets, priority 1 products derived from imaging and/or sounding assets shall

remain at 99% for the primary CONUS areas. Products outside this zone may be degraded as remaining assets cover both imaging and sounding requirements. Overall, the availability (in time and space) of any priority 1 product shall be no less than 83% (threshold) with an objective of 89%, while certain to-be-selected high priority products outside the CONUS zone will continue to have an availability of at least 99%. The selected high priority products will be identified in PDR II.

		Threshold		Goal	
		Imaging	Sounding	Imaging	Sounding
No move to middle	West	85%	85%	95%	95%
	Central	85%	85%	95%	95%
	East	85%	85%	95%	95%
Permit moving one SAT (imaging or sounding) to middle	West	83%	83%	89%	89%
	Central	93%	93%	99%	99%
	East	83%	83%	89%	89%
Permit moving sounding to middle	West	85%	83%	95%	89%
	Central	85%	93%	95%	99%
	East	85%	83%	95%	89%
Permit moving one SAT (Imaging or Sounding) to middle for limited time	West	81%	81%	86%	86%
	Central	89%	89%	97%	97%
	East	81%	81%	86%	86%

3.2.2 System Lifetime

All segments of the system shall be designed to support mission requirements for at least a 14-year period after IOC.

3.2.3 Data Continuity

3.2.3.1 DURING ECLIPSE PERIODS

Data shall be provided continuously through eclipse periods. Sensing shall include acquisition of data from the imaging and sounding instruments (threshold), and acquisition of data from all other instruments (objective).

3.2.3.2 AFTER SPACECRAFT MANEUVERS

Disruption of data continuously after maneuvers shall be no greater than 1 hour. Maneuvers should also be scheduled to minimize data continuity gaps during NWS Critical Weather Events.

3.2.4 Imagery Sensing

3.2.4.1 SPATIAL COVERAGE

The GOES R Series imagery capability shall provide images 1) of the Full Earth disk, 2) over the contiguous United States (CONUS) (3000 x 5000 km) and 3) selectable mesoscale sectors (1000 x 1000 km).

3.2.4.2 CONCURRENT COVERAGE

The GOES R series imagery capability shall permit interleaved acquisition of images of the Full Earth disk, of the CONUS, and in mesoscale concurrently.

3.2.5 Performance Around Local Midnight

Performance requirements around local midnight shall be comparable to daylight performance requirements.

3.2.6 Capability Growth

Capability to accommodate additional prototype sensors shall be provided.

3.3 C^3 SEGMENT REQUIREMENTS

Under the GOES-R program, the hardware and software located at the primary and back-up CDAs and the SOCC shall ensure a seamless transition from legacy to GOES-R series operations. This seamless transition shall also apply to backup operations, continuity of data flow and processing, and ease of maintenance. The GOES-R series and the legacy series are independent, i.e., the satellites in both series will have overlapped operations and these operations shall not interfere with each other. The GOES-R series primary and backup CDAs and the SOCC shall have functionally identical computer system architectures and specific programs that are operated and maintained using the same commands and procedures. C^3 Segment processes shall be modular to scale to changing requirements, reduce maintenance and promote reusability. The C^3 Segment equipment shall be in place and operational at the primary and backup CDAs and SOCC prior to start of spacecraft Integration and Test (I & T). The C^3 Segment shall provide three spacecraft simulators.

3.3.1 General Requirements

The C^3 Segment shall support GOES-R series operational observatories as the primary GOES-R series functions.

The C^3 Segment shall process data from communication links that are compatible with CCSDS Forward Error Correction (FEC) coding and framing processes.

The C^3 Segment communication links and communication link interfaces for the raw and processed data shall be sized to provide for future growth in the data volume and sources without additional major changes to the communications architecture of the C^3 Segment.

The changes to the auxiliary GOES communications links (LRIT, EMWIN, DCPI, DCPR, SARSAT) caused by the high data rate requirements of the enhanced imagery and sounding capabilities shall be avoided. These links shall utilize existing antennas.

All C^3 Segment communication links to and from the Space Segment (with exception of search and rescue, and surface data collection transmissions) shall provide controlled access to Command and Control functions.

The C^3 Segment shall accommodate secure transmission of data based on National Space Policy Directives and Executive Charter (NSPD) policies in force at FOC.

The C^3 Segment shall have the computer capacity to ingest, process, and store as a temporal archive, all raw data required to produce the full complement of GOES-R series data and products as projected for FOC. The intent is to support the full GOES-R constellation and any legacy GOES satellites that may be on orbit.

The C^3 Segment shall be designed with no single point failures. The design shall incorporate the allocation of System Availability to the C^3 Segment. This incorporation shall be substantiated with:

1) published equipment MTBF for all hardware components
2) reliability analyses addressing redundancies.

Element and Data Flow Monitoring shall be provided for C^3 Segment hardware, software and data flows at a level sufficient to detect errors/problems and extract related information. C^3 Segment staff shall be notified of any errors/problems and shall be provided with all related information.

All C^3 Segment hardware and software shall be described in appropriate engineering documentation that includes, but is not limited to, Design documentation, Operations and Maintenance manuals, and Interface Control Documents.

The C^3 Segment shall allow maintenance to be performed on a non-interference basis with C^3 Segment operations. Both remedial and preventive maintenance shall be provided for all C^3 Segment elements during installation, system checkout and acceptance, Initial Operational Capability (IOC), FOC and extended maintenance periods as defined by NOAA.

3.3.2 Data Access

As a threshold, the GOES-R series spacecraft will be capable of selectively denying all U.S. environmental sensor data (excepting DCS and SARSAT) that are a part of the GOES series constellation, during contingencies or conflicts. The C^3 Segment shall be transparent to both the initiation and cessation of data denial actions and shall maintain operations appropriate to the initiation, duration and cessation of data denial actions.

3.3.3 Information Integrity

The C^3 Segment data communications links shall maintain and guarantee the integrity of all information elements exchanged. Information integrity shall be at least 99.99% (with an objective of 99.999%).

3.3.4 Data Availability to Operations Centers

The C^3 Segment shall provide 99.9% (threshold), and 99.99% (objective), (on a monthly basis) of the data received from the Space Segment for each GOES-R series satellite to the Product Generation and Distribution (PGD) Segment.

3.3.5 Data Availability to Direct Readout Sites

The C^3 Segment shall provide for continuously transmitted data as it is received from the ground station for acquisition by any suitably equipped direct readout site.

3.3.6 C^4I System Integration

The GOES-R series satellites program acquisition and design shall conform, with USG approval, to industry standards for Compatibility and Integration of Command, Control, Communications, Computers, and Intelligence (C^4I), where applicable. The design must address an open systems environment and interoperability with supported C^4I systems.

3.3.7 C^3 Segment Functional Elements

The GOES-R C^3 Segment shall include, but not be limited to, the functional elements presented in the following paragraphs. The implementation of this functionality shall minimize changes to existing operational processes and shall maximize the use of GOES-N series antennas.

3.3.7.1 GOES ANTENNA SYSTEM TRACKING (GAST)

The C^3 Segment shall interface with the GOES antenna systems and GAST shall be available at the NOAA CDAS and Backup CDAS (BUCDAS) facilities.

3.3.7.2 GOES TELEMETRY & COMMAND (GTC)

GTC shall include the following functions:

1) all spacecraft and instrument housekeeping
2) all health & safety telemetry processing and monitoring
3) all spacecraft command operations
4) all configuration monitoring and control for all other ground system components
5) archive all C^3 Segment telemetry.

GTC shall be available at the NOAA SOCC, CDAS, and BUCDAS facilities.

3.3.7.3 GOES SCHEDULING (GS)

GS shall support spacecraft operations scheduler planning and shall perform generation of all scheduled spacecraft command sequences (either ground or onboard executed). GS shall be available at the NOAA SOCC, CDAS, and BUCDAS facilities.

3.3.7.4 GOES ORBIT AND ATTITUDE TRACKING (GOAT)

GOAT shall include the following functions:

1) provide for Predictive Orbit and Attitude
2) provide for onboard propellant management ('fuel remaining' monitoring)

3) monitor spacecraft attitude and INR performance in real-time;
4) support all spacecraft station keeping and attitude maneuvers.

The GOAT shall be available at the NOAA SOCC, CDAS, and BUCDAS facilities.

3.3.7.5 GOES SENSOR PROCESSING (GSP)

GSP shall include the following functions:
1) ingest and process instrument wideband data;
2) perform calibration determination and INR to produce level 1B products;
3) extract and archive offline radiometric and INR analysis data;
4) extract and distribute, in real-time, radiometric and instrument housekeeping data to the GTC element and INR observation data to the GOAT element;
5) package and distribute instrument data.

GSP shall be available at the NOAA CDAS and BUCDAS facilities and shall be available at the NOAA SOCC for system development and software maintenance.

3.3.7.6 GOES PRODUCT MONITOR (GPM)

The GPM shall ingest the user-packaged science data and shall perform radiometric data quality monitoring. The GPM shall be available at the NOAA SOCC, CDAS, and BUCDAS facilities.

3.3.7.7 GOES ENGINEERING ANALYSIS (GEA)

GEA shall include the following functions (to the extent supported by the spacecraft):
1) ingest and decommutate spacecraft diagnostic data;
2) provide for access to satellite telemetry;
3) extract and distribute any housekeeping data to the GTC element for instruments having data contained within downlinked spacecraft diagnostic data.

GEA shall be available at the NOAA SOCC, CDAS, and BUCDAS facilities.

3.3.8 Communication Links

For the following required broadcasts there is a baseline and numerous options are available in the area of communication links. Most cannot be decided until the nominal imaging, and particularly sounding, capabilities are more firmly established for the GOES-R series. Numerous trade studies on data compression and options on use of specific frequencies need to continue until the GOES-R series design and capabilities are established. These links shall work with U.S. Government RF.

3.3.8.1 RAW SENSOR (SD)

The raw data transmission includes data from all the spacecraft observatories. The C^3 Segment shall be capable of receiving all sensor data from the SD link(s) at USG specified frequency bands, rates, coding/framing, and modulation.

3.3.8.2 GOES RE-BROADCAST (GRB)

The GOES Re-broadcast (GRB) consists of a set of processed, calibrated and earth-referenced instrument data that is broadcast to users after processing at the CDAS/BUCDAS. The C^3 Segment shall broadcast the GRB to the user community.

3.3.8.3 LOW RATE INFORMATION TRANSMISSION (LRIT)

The C^3 Segment shall be capable of providing LRIT functions as continuing service.

3.3.8.4 EMERGENCY MANAGERS WEATHER INFORMATION NETWORK (EMWIN)

The C^3 Segment shall be capable of providing EMWIN functions as continuing service.

3.3.8.5 DATA COLLECTION PLATFORM INTERROGATION (DCPI)

The C^3 Segment shall be capable of providing DCPI functions as continuing service.

3.3.8.6 DATA COLLECTION PLATFORM RESPONSE (DCPR)

The C^3 Segment shall be capable of providing DCPR functions as continuing service.

3.3.8.7 SEARCH AND RESCUE SATELLITE AIDED TRACKING (SARSAT)

The C^3 Segment shall be capable of providing SARSAT functions as continuing service.

3.3.8.8 TELEMETRY AND COMMAND (T&C)

The C^3 Segment T&C links shall consist of: Telemetry to/from the GOES-R satellites; Telemetry to/from DSN stations; Command and Command-table loads from either CDA or BUCDA stations; DSN ranging telemetry.

3.3.9 C^3 Segment Interfaces

Interfaces with the C^3 Segment shall include, but not be limited to, the following:

1) NASA Deep Space Network (DSN) stations
2) Functional elements located at the CDA, BUCDA, SEC, GSFC, SOCC
3) NASA (to acquire orbital element sets)
4) CLASS (Archive Segment)
5) Auxiliary link services as required.

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3.4 PRODUCT GENERATION AND DISTRIBUTION (PGD) SEGMENT REQUIREMENTS

The PGD Segment shall have the ability to receive raw mission data from the Command, Control & Communications (C^3) Segment, process the data into Level 1 datasets and further into Level 2 derived products, store both Level 1 and Level 2 and surface data collection/location products in a database management system. The PGD Segment shall have sufficient temporary storage capacity to store ancillary data required for product generation and to store all products until the data can be delivered to users. The PGD segment processes shall be modular to reduce maintenance and promote reusability. At final design, the PGD Segment shall be designed to permit 100% growth of the projected Full Operational Capability (FOC) storage and processing capacity.

The guiding principles of the NOAA PGD segment are free and open access to all data, with full resolution data available and archived. The PGD shall have the capability to distribute (i.e., within the government system) and disseminate (i.e., external to the government system) all GOES-R data and data products to user communities.

The core GOES-R PGD requirements are:

- Near full resolution, tailored data stream distributed to the National Centers for Environmental Prediction (NCEP) Environmental Modeling Center (EMC), Air Force Weather Agency (AFWA), Fleet Numerical Meteorology and Oceanography Center (FNMOC);
- General access to all data at one or more locations;
- Continuation of GOES Variable Format (GVAR) level rebroadcast;
- A second GOES Re-broadcast of a selected set of data and products tailored for maximum benefit to a large number of users and tailored for maximum efficiency of the retransmission system.

The GOES-R spacecraft will support seven types of data re-broadcast to users:

- Search and Rescue Satellite Aided Tracking (SARSAT)
- Emergency Managers Weather Information Network (EMWIN)
- Low Rate Information Transmission (LRIT)
- Data Collection System (DCS)
- GOES Re-Broadcast (GRB), the corollary to the current GVAR
- New solar environment instruments
- Instrument(s) of Opportunity (IOO), e.g., SEI, Volcam, etc.

The SARSAT, EMWIN, LRIT, DCS and GRB will all experience data rate or functional expansion, and changes in frequency and/or modulation type, but otherwise be the basic downlink they are to current users.

3.4.1 Product Latency

Product Latency is defined as the period from the Time of Observation of all requisite data by the satellite until the product produced by that data is available at the User interface. DOC requires that 95% (threshold) and 99.8% (objective) (on a monthly average) of the observable data collected by each GOES-R satellite shall be delivered to users per the product latency requirements specified in each section.

3.4.2 Geolocation of Data

GOES-R satellite location and attitude information shall be provided with environmental data, as a threshold, to accurately locate the data source using the current Government-accepted version of the World Geodetic Standard ellipsoid. The GOES-R products shall be referenced to a currently accepted digital elevation model, such as Digital Topographic Elevation Data (DTED) Level II.

3.4.3 Background *TBW*

For the observational requirements:

Requirement Level:

"T" = Threshold / The minimum requirement below which utility of the system becomes questionable.

"O" = Objective / An operationally significant increment above the threshold.

Priority Categories associated with a User:

"1" = Mission Critical / Cannot meet operational mission objectives without this data

"2" = Mission Optimal / Data not critical but would provide significant improvement to operational capability

"3" = Mission Enhancing / Needed to enhance state of knowledge / assess potential for operational capability

"UA" = Unassigned at this time

Geographic Coverage:

"C" = CONUS Coverage / Contiguous US / 3000 km N/S x approx 5000 km E/W Target Area (4000km northern boundary, 6000 km southern boundary) centered at 38.2 N Lat / 96 W Lon

"FD" = Full Disk Coverage / A region defined as the combined earth area viewed from the nominal GOES R system longitudinal positions

"G" = Global Coverage / Self-explanatory

"H" = Hemispheric Coverage / West Boundary of 150 deg E and an East Boundary of zero (0) deg Meridian

"M" = Mesoscale "Non-Routine" Coverage / 1000 km N/S x 1000 km E/W Relocatable Target Area within Hemispheric Coverage Area requested on an as needed basis

3.4.4 Performance Characteristics: Atmosphere / Aerosols

3.4.4.1 AEROSOL DETECTION: CONUS (INCLUDING SMOKE AND DUST)

3.4.4.1.1 Definition

Summary, mapping of the extent of smoke/aerosol coverage, smoke albedo estimates (distribution and relative intensity). Used to document trends in biomass burning and to estimate the impact of biomass burning on human health, ecology, and climate change [*GOES Products and Services Catalog*].

Attribute		Threshold	Objective
3.4.4.1.2	*User & Priority Category*	NWS/WFO-1 OAR/AOML/HRD-2	NWS/WFO-1 OAR/AOML/HRD-2
3.4.4.1.3	*Geographic Coverage*	CONUS	CONUS
3.4.4.1.4	*Vertical Resolution*	Total Column	1 km
3.4.4.1.5	*Horizontal Resolution*	2 km	1 km
3.4.4.1.6	*Mapping Accuracy*	1 km	0.2 km
3.4.4.1.7	*Measurement Range*	Binary yes/no detection	Binary yes/no detection
3.4.4.1.8	*Measurement Accuracy*	TBD	TBD
3.4.4.1.9	*Refresh Rate*	60 min	15 min
3.4.4.1.10	*Data Latency*	15 min	3 min
3.4.4.1.11	*Long-term Stability*	TBD	TBD

3.4.4.2 AEROSOL DETECTION: HEMISPHERIC (INCLUDING SMOKE AND DUST)

3.4.4.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.4.2.2	*User & Priority Category*	NWS/WFO-1 NWS/NCEP/EMC-1 NWS/NCEP/AWC-1 OAR/AOML/HRD-2 NESDIS/OSDPD-1/2 NESDIS/ORA-3 OAR/FSL-3	NWS/WFO-1 NWS/NCEP/EMC-1 NWS/NCEP/AWC-1 OAR/AOML/HRD-2 NESDIS/OSDPD-1/2 NESDIS/ORA-3 OAR/FSL-3
3.4.4.2.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.4.2.4	*Vertical Resolution*	Total Column	1 km
3.4.4.2.5	*Horizontal Resolution*	2 km	0.5 km
3.4.4.2.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.4.2.7	*Measurement Range*	1 - 10 miles	1 - 10 miles
3.4.4.2.8	*Measurement Accuracy*	within 1 mile	within 1 mile
3.4.4.2.9	*Refresh Rate*	60 min	10 min
3.4.4.2.10	*Data Latency*	3 min	3 min
3.4.4.2.11	*Long-term Stability*	TBD	TBD

3.4.4.3 AEROSOL DETECTION: MESOSCALE (INCLUDING SMOKE AND DUST)

3.4.4.3.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.4.3.2	*User & Priority Category*	NWS/WFO-1 OAR/AOML/HRD-2	NWS/WFO-1 OAR/AOML/HRD-2
3.4.4.3.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.4.3.4	*Vertical Resolution*	TBD	TBD
3.4.4.3.5	*Horizontal Resolution*	2 km	2 km
3.4.4.3.6	*Mapping Accuracy*	1 km	1 km
3.4.4.3.7	*Measurement Range*	TBD	TBD
3.4.4.3.8	*Measurement Accuracy*	TBD	TBD
3.4.4.3.9	*Refresh Rate*	15 min	15 min
3.4.4.3.10	*Data Latency*	15 min	15 min
3.4.4.3.11	*Long-term Stability*	TBD	TBD

3.4.4.4 AEROSOL PARTICLE SIZE

3.4.4.4.1 Definition

Measurement of the bimodal size distribution of the aerosol population in terms of the effective radius r_e and effective variance v_e of each mode. The effective radius is the ratio of the third moment of the aerosol size distribution to the second moment. The effective variance characterizes the width of the size distribution. The refresh requirement for the climate products is to provide observations from the satellite nadir-track of any satellite carrying the aerosol polarimeter. The requirements below apply only under clear conditions.

Attribute		Threshold	Objective
3.4.4.4.2	*User & Priority Category*	NWS/WFO-1 NWS/NCEP/EMC-1 NESDIS/ORA-3 OAR/FSL-3 DoD/USN-USMC-1	NWS/WFO-1 NWS/NCEP/EMC-1 NESDIS/ORA-3 OAR/FSL-3 DoD/USN-USMC-1
3.4.4.4.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.4.4.4	*Vertical Resolution*	Total Column	0.5 km
3.4.4.4.5	*Horizontal Resolution*	2 km	0.5 km
3.4.4.4.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.4.4.7	*Measurement Range*	TBD	TBD
3.4.4.4.8	*Measurement Accuracy*	TBD	TBD
3.4.4.4.9	*Refresh Rate*	15 min	10 min
3.4.4.4.10	*Data Latency*	5 min	5 min
3.4.4.4.11	*Long-term Stability*	TBD	TBD

3.4.4.5 DUST / AEROSOL: LOADING: CONUS

3.4.4.5.1 Definition

Solid materials suspended in the atmosphere in the form of small, irregular particles, many of which are microscopic in size. Dust is due to biogenic and anthropogenic sources such as volcanic eruptions, salt spray, plant pollen, smoke, industrial processes, etc. [*NASA Global Change Master Directory*].

Attribute		Threshold	Objective
3.4.4.5.2	*User & Priority Category*	NESDIS/OSDPD-2	NESDIS/OSDPD-2
3.4.4.5.3	*Geographic Coverage*	CONUS	CONUS
3.4.4.5.4	*Vertical Resolution*	Total	TBD
3.4.4.5.5	*Horizontal Resolution*	10 km	1 km
3.4.4.5.6	*Mapping Accuracy*	5 km	0.2 km
3.4.4.5.7	*Measurement Range*	Light/Mod/Heavy	TBD
3.4.4.5.8	*Measurement Accuracy*	TBD	TBD
3.4.4.5.9	*Refresh Rate*	60 min	15 min
3.4.4.5.10	*Data Latency*	3 min	3 min
3.4.4.5.11	*Long-term Stability*	TBD	TBD

3.4.4.6 DUST / AEROSOL: LOADING: HEMISPHERIC

3.4.4.6.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.4.6.2	*User & Priority Category*	NESDIS/ORA-3	NESDIS/ORA-3
3.4.4.6.3	*Geographic Coverage*	62˚ LZA	Hemispheric
3.4.4.6.4	*Vertical Resolution*	Total	TBD
3.4.4.6.5	*Horizontal Resolution*	10 km	2 km
3.4.4.6.6	*Mapping Accuracy*	5 km	TBD
3.4.4.6.7	*Measurement Range*	Light/Mod/Heavy	TBD
3.4.4.6.8	*Measurement Accuracy*	TBD	TBD
3.4.4.6.9	*Refresh Rate*	60 min	TBD
3.4.4.6.10	*Data Latency*	TBD	TBD
3.4.4.6.11	*Long-term Stability*	TBD	TBD

3.4.4.7 SUSPENDED MATTER: CONUS

3.4.4.7.1 Definition

Fine solids suspended in the air. The threshold content of this observational requirement is to report the presence of suspended matter such as dust, sand, volcanic ash, SO_2, or smoke at any altitude.

Attribute		Threshold	Objective
3.4.4.7.2	*User & Priority Category*	NWS/NCEP/AWC-1 NWS/NCEP/EMC-1 NWS/WFO –1 NWS/NCEP/OPC-3	NWS/NCEP/AWC-1 NWS/NCEP/EMC-1 NWS/WFO –1 NWS/NCEP/OPC-3
3.4.4.7.3	*Geographic Coverage*	CONUS	CONUS
3.4.4.7.4	*Vertical Resolution*	Total Column	Total Column
3.4.4.7.5	*Horizontal Resolution*	2 km	0.5 km
3.4.4.7.6	*Mapping Accuracy*	1 km	0.2 km
3.4.4.7.7	*Measurement Range*	TBD	TBD
3.4.4.7.8	*Measurement Accuracy*	TBD	TBD
3.4.4.7.9	*Refresh Rate*	5 min	1 min
3.4.4.7.10	*Data Latency*	1 min	1 min
3.4.4.7.11	*Long-term Stability*	TBD	TBD

3.4.4.8 SUSPENDED MATTER: HEMISPHERIC

3.4.4.8.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.4.8.2	*User & Priority Category*	NWS/NCEP/AWC-1 NWS/NCEP/EMC-1 NWS/WFO -1 NWS/NCEP/OPC-3 DoD/USAF-1 Europeans-UA	NWS/NCEP/AWC-1 NWS/NCEP/EMC-1 NWS/WFO -1 NWS/NCEP/OPC-3 DoD/USAF-1 Europeans-UA
3.4.4.8.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.4.8.4	*Vertical Resolution*	Total Column	Total Column
3.4.4.8.5	*Horizontal Resolution*	2 km	0.5 km
3.4.4.8.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.4.8.7	*Measurement Range*	TBD	TBD
3.4.4.8.8	*Measurement Accuracy*	TBD	TBD
3.4.4.8.9	*Refresh Rate*	15 min	5 min
3.4.4.8.10	*Data Latency*	3 min	1 min
3.4.4.8.11	*Long-term Stability*	TBD	TBD

3.4.4.9 VOLCANIC ASH: DETECTION AND HEIGHT

3.4.4.9.1 Definition

Solid volcanic materials suspended in the atmosphere in the form of small, irregular particles, many of which are microscopic in size.

Attribute		Threshold	Objective
3.4.4.9.2	*User & Priority Category*	NESDIS/OSDPD-1 NWS/NCEP/EMC-1 NWS/WFO -1 OAR/FSL-3 NESDIS/ORA-3	NESDIS/OSDPD-1 NWS/NCEP/EMC-1 NWS/WFO -1 OAR/FSL-3 NESDIS/ORA-3
3.4.4.9.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.4.9.4	*Vertical Resolution*	2 km (Top Height)	0.5 km
3.4.4.9.5	*Horizontal Resolution*	2 km	0.5 km
3.4.4.9.6	*Mapping Accuracy*	1.0 km	0.1 km
3.4.4.9.7	*Measurement Range*	0 - 50 tons/km^2	0 - 50 tons/km^2 (1 ton = 1000 kg)
3.4.4.9.8	*Measurement Accuracy*	2 tons/km^2	0.3 tons/km^2
3.4.4.9.9	*Refresh Rate*	15 min	5 min
3.4.4.9.10	*Data Latency*	1 min	30 sec
3.4.4.9.11	*Long-term Stability*	TBD	TBD

3.4.5 Performance Characteristics: Atmosphere / Clouds

3.4.5.1 AIRCRAFT ICING THREAT

3.4.5.1.1 Definition

Detection of supercooled water clouds conducive to in-flight aircraft icing. Qualitative assessment of the threat of formation and accumulation of ice, rime, or hoarfrost on an aircraft. Also called airframe icing and aircraft ice accretion [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.5.1.2	*User & Priority Category*	NESDIS/ORA-3	NESDIS/ORA-3
3.4.5.1.3	*Geographic Coverage*	62˚ LZA	Hemispheric
3.4.5.1.4	*Vertical Resolution*	1 km (top height)	0.5 km
3.4.5.1.5	*Horizontal Resolution*	10 km	2 km
3.4.5.1.6	*Mapping Accuracy*	5 km	< 0.5 km
3.4.5.1.7	*Measurement Range*	None – Heavy	None – Heavy
3.4.5.1.8	*Measurement Accuracy*	2 categories	1 category
3.4.5.1.9	*Refresh Rate*	60 min	30 min
3.4.5.1.10	*Data Latency*	15 min	5 min
3.4.5.1.11	*Long-term Stability*	TBD	TBD

3.4.5.2 CLOUD BASE HEIGHT: CONUS

3.4.5.2.1 Definition

Height above ground level where cloud bases occur. For a given cloud or cloud layer, the lowest height in the atmosphere at which the air contains a perceptible quantity of cloud particles [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.5.2.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 OAR/FSL-3	NWS/NCEP/OPC-1 OAR/FSL-3
3.4.5.2.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.2.4	*Vertical Resolution*	2 km	0.1 km
3.4.5.2.5	*Horizontal Resolution*	10 km	1 km
3.4.5.2.6	*Mapping Accuracy*	5 km	0.2 km
3.4.5.2.7	*Measurement Range*	0 - TBD	0 - 1 km
3.4.5.2.8	*Measurement Accuracy*	2 km	0.1 km
3.4.5.2.9	*Refresh Rate*	60 min	5 min
3.4.5.2.10	*Data Latency*	1 min	1 min
3.4.5.2.11	*Long-term Stability*	TBD	TBD

3.4.5.3 CLOUD BASE HEIGHT: HEMISPHERIC

3.4.5.3.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.3.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NESDIS/ORA-3 Climate-1 DoD/USAF-1 Europeans-UA	NWS/NCEP/OPC-1 NESDIS/ORA-3 Climate-1 DoD/USAF-1 Europeans-UA
3.4.5.3.3	*Geographic Coverage*	62˚ LZA	Hemispheric
3.4.5.3.4	*Vertical Resolution*	2 km	0.5 km
3.4.5.3.5	*Horizontal Resolution*	10 km	1 km
3.4.5.3.6	*Mapping Accuracy*	5 km	0.2 km
3.4.5.3.7	*Measurement Range*	0 - TBD	0 - 30 km
3.4.5.3.8	*Measurement Accuracy*	2 km	0.1 km
3.4.5.3.9	*Refresh Rate*	60 min	5 min
3.4.5.3.10	*Data Latency*	3 min	1 min
3.4.5.3.11	*Long-term Stability*	TBD	0.1 km

3.4.5.4 CLOUD BASE HEIGHT: MESOSCALE

3.4.5.4.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.4.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 OAR/NSSL-1	NWS/NCEP/OPC-1 OAR/NSSL-1
3.4.5.4.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.4.4	*Vertical Resolution*	2 km	0.5 km
3.4.5.4.5	*Horizontal Resolution*	4 km	0.2 km
3.4.5.4.6	*Mapping Accuracy*	2 km	0.1 km
3.4.5.4.7	*Measurement Range*	0 - TBD	0 - 1 km
3.4.5.4.8	*Measurement Accuracy*	2 km	0.1 km
3.4.5.4.9	*Refresh Rate*	5 min	1 min
3.4.5.4.10	*Data Latency*	1 min	1 min
3.4.5.4.11	*Long-term Stability*	TBD	TBD

3.4.5.5 CLOUD ICE WATER PATH: CONUS

3.4.5.5.1 Definition

A measure of the equivalent water mass of the ice particles in a unit vertical column through the cloud. Measured information is dependent on the number of particles, their sizes, and their densities.

Attribute		Threshold	Objective
3.4.5.5.2	*User & Priority (LO-#)*	NWS/WFO-2 NWS/NCEP/OPC-3	NWS/WFO-2 NWS/NCEP/OPC-3
3.4.5.5.3	*Geographic Coverage*	CONUS - for limited cloudiness	CONUS
3.4.5.5.4	*Vertical Resolution*	SURFACE - 20 km	SURFACE - 20 km
3.4.5.5.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.5.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.5.7	*Measurement Range*	0 - 2 mm (Day) 0 - 0.2 mm (Night)	0 - 2 mm
3.4.5.5.8	*Measurement Accuracy*	Greater of 0.1 mm or 25%; only thinnest clouds at night.	Greater of 0.05 mm or 10%
3.4.5.5.9	*Refresh Rate*	5 min	1 min
3.4.5.5.10	*Data Latency*	1 min	1 min
3.4.5.5.11	*Long-term Stability*	TBD	TBD

3.4.5.6 CLOUD ICE WATER PATH: HEMISPHERIC

3.4.5.6.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.6.2	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/EMC-2 NWS/NCEP/OPC-3 Europeans - UA	Climate-1 NWS/NCEP/EMC-2 NWS/NCEP/OPC-3 Europeans - UA
3.4.5.6.3	*Geographic Coverage*	Full Disk - for limited cloudiness	Hemispheric
3.4.5.6.4	*Vertical Resolution*	Surface - 20 km	Surface - 20 km
3.4.5.6.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.6.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.6.7	*Measurement Range*	0 - 2 mm (Day) 0 - 0.2 mm (Night)	0 - 2 mm
3.4.5.6.8	*Measurement Accuracy*	Greater of 0.1 mm or 25%; only thinnest clouds at night.	Greater of 0.05 mm or 10%
3.4.5.6.9	*Refresh Rate*	15 min	15 min
3.4.5.6.10	*Data Latency*	1 min	1 min
3.4.5.6.11	*Long-term Stability*	TBD	5%

3.4.5.7 CLOUD ICE WATER PATH: MESOSCALE

3.4.5.7.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.7.2	*User & Priority (LO-#)*	NWS/WFO-2 NWS/NCEP/OPC - 3 OAR/NSSL-2	NWS/WFO-2 NWS/NCEP/OPC - 3 OAR/NSSL-2
3.4.5.7.3	*Geographic Coverage*	Mesoscale - for limited cloudiness	Mesoscale
3.4.5.7.4	*Vertical Resolution*	Surface - 20 km	Surface - 20 km
3.4.5.7.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.7.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.7.7	*Measurement Range*	0 - 2 mm (Day) 0 - 0.2 mm (Night)	0 - 2 mm
3.4.5.7.8	*Measurement Accuracy*	Day: Greater of 0.1 mm or 25% Night: <50%	Greater of 0.05 mm or 10%
3.4.5.7.9	*Refresh Rate*	5 min	1 min
3.4.5.7.10	*Data Latency*	1 min	1 min
3.4.5.7.11	*Long-term Stability*	TBD	TBD

3.4.5.8 CLOUD IMAGERY: COASTAL

3.4.5.8.1 Definition

The requirement is for:

- All weather, day/night imagery of selected regions
- Low-light imagery - using reflected moonlight - visible near infrared (VNIR) portion of the spectrum, typically 0.4 - 1.5 μm
  Reference: From a USGS table, for example, the VIS is 0.4 - 0.7 μm and the NIR is 0.7 - 1.5 μm
- Imagery within the thermal or infrared portion of the spectrum (typically 1.5 μm to 1.0 mm)
  Reference: Same as above
- Specialized imagery within the visible portion of the spectrum (typically 0.4 - 0.7 μm)
  - Near, Shortwave Infrared, Water Vapor - 500 mb, Water Vapor - 30 mb, Infrared Window, Infrared "dirty" Window, Infrared CO_2

Specialized imagery is required at sufficient resolution to enable discernment of environmental phenomena (by either manual analysis or automated algorithms) within the visible portion of the spectrum (typically, 0.4 - 0.7 μm). The cloud and moisture imagery shall be able to depict clouds, water vapor, lights from human settlements, fires, gas flares, and heavily lit fishing boats. Environmental phenomena range in size from cloud types and elements to planetary scale (10^7 km^2) weather patterns [*Intergovernmental Panel on Climate Change*]. The cloud and moisture imagery shall provide digital input, through single bands and/or combinations of band/channels, to remote sensing algorithms that produce other environmental measurements, although this does not replace the explicit requirement for retrieval of individual parameters described elsewhere in this document.

Attribute		Threshold	Objective
3.4.5.8.2	*User & Priority Category*	NOS/NGS-2 NOS/NCOOS-2	NOS/NGS-2 NOS/NCOOS-2
3.4.5.8.3	*Geographic Coverage*	U.S. navigable waters thru EEZ	U.S. navigable waters thru EEZ
3.4.5.8.4	*Vertical Resolution*	TBD	TBD
3.4.5.8.5	*Horizontal Resolution*	Day: 1 km Night: 2 km	1 km
3.4.5.8.6	*Mapping Accuracy*	≤1 km	≤1 km
3.4.5.8.7	*Measurement Range*	TBD	TBD
3.4.5.8.8	*Refresh Rate*	180 min	60 min
3.4.5.8.9	*Data Latency*	15 min	15 min
3.4.5.8.10	*Long-term Stability*	TBD	TBD

3.4.5.9 CLOUD LAYERS / HEIGHTS AND THICKNESS: CONUS

3.4.5.9.1 Definition

The heights of the cloud layer bases above local terrain or above mean sea level. Cloud layer thickness is defined as the vertical distance from the cloud base to the cloud top; more commonly referred to as the "thickness" or "depth" of the cloud [*Glossary of Weather and Climate*].

Attribute		Threshold	Objective
3.4.5.9.2	*User & Priority (LO-#)*	OAR/FSL – 3 DoD/USA-1	OAR/FSL – 3 DoD/USA-1
3.4.5.9.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.9.4	*Vertical Resolution*	TBD	Sfc-1 km: 30 km 1-3 km: 150m >3km: 300 m
3.4.5.9.5	*Horizontal Resolution*	10 km	0.25 km
3.4.5.9.6	*Mapping Accuracy*	5 km	0.5 km
3.4.5.9.7	*Measurement Range*	Thickness: only by general cloud type. Heights of up to 5 layers	Thickness: only by general cloud type. Heights of up to 5 layers
3.4.5.9.8	*Measurement Accuracy*	Thickness: TBD Height: TBD	Thickness: TBD Height: TBD
3.4.5.9.9	*Refresh Rate*	60 min	15 min
3.4.5.9.10	*Data Latency*	15 min	1 min
3.4.5.9.11	*Long-term Stability*	TBD	TBD

3.4.5.10 CLOUD LAYERS / HEIGHTS AND THICKNESS: HEMISPHERIC

3.4.5.10.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.10.2	*User & Priority (LO-#)*	Climate-1 NESDIS/ORA-3 DoD/USN-USMC-1 DoD/USA-1	Climate-1 NESDIS/ORA-3 DoD/USN-USMC-1 DoD/USA-1
3.4.5.10.3	*Geographic Coverage*	62 deg LZA	Hemispheric
3.4.5.10.4	*Vertical Resolution*	TBD	Sfc-2 km: 30 km 2 - 20 km: 150m >3km: 300 m
3.4.5.10.5	*Horizontal Resolution*	10 km	2 km
3.4.5.10.6	*Mapping Accuracy*	5 km	TBD
3.4.5.10.7	*Measurement Range*	Thickness: only by general cloud type. Heights of up to 5 layers	TBD
3.4.5.10.8	*Measurement Accuracy*	Thickness: TBD Height: TBD	TBD
3.4.5.10.9	*Refresh Rate*	60 min	15 min
3.4.5.10.10	*Data Latency*	TBD	TBD
3.4.5.10.11	*Long-term Stability*	TBD	TBD

3.4.5.11 CLOUD LAYERS / HEIGHTS AND THICKNESS: MESOSCALE

3.4.5.11.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.11.2	*User & Priority (LO-#)*	DoD/USA-1	DoD/USA-1
3.4.5.11.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.11.4	*Vertical Resolution*	TBD	Sfc-1 km: 30 km 1-3 km: 150m >3km: 300 m
3.4.5.11.5	*Horizontal Resolution*	4 km	TBD
3.4.5.11.6	*Mapping Accuracy*	2 km	TBD
3.4.5.11.7	*Measurement Range*	Thickness: only by general cloud type. Heights of up to 5 layers	Sfc-2 km: 30 km 2 - 20 km: 150m >3km: 300 m
3.4.5.11.8	*Measurement Accuracy*	Thickness: TBD Height: TBD	Thickness: TBD Height: TBD
3.4.5.11.9	*Refresh Rate*	5 min	TBD
3.4.5.11.10	*Data Latency*	10 min	10 min
3.4.5.11.11	*Long-term Stability*	TBD	TBD

3.4.5.12 CLOUD LIQUID WATER: CONUS

3.4.5.12.1 Definition

Cloud Liquid Water is the amount of liquid water per unit volume of air [*Wallace and Hobbs*].

Attribute		Threshold	Objective
3.4.5.12.2	*User & Priority (LO-#)*	OAR/FSL-3	OAR/FSL-3
3.4.5.12.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.12.4	*Vertical Resolution*	Total Column	SURFACE – 20 km
3.4.5.12.5	*Horizontal Resolution*	2 km	1 km
3.4.5.12.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.12.7	*Measurement Range*	0 - 1 mm	0 - 2 mm
3.4.5.12.8	*Measurement Accuracy*	Day: Greater of 0.1 mm or 25% Night:<50%	Day: Greater of 0.1 mm or 25% Night:<50%
3.4.5.12.9	*Refresh Rate*	30 min	15 min
3.4.5.12.10	*Data Latency*	15 min	1 min
3.4.5.12.11	*Long-term Stability*	TBD	TBD

3.4.5.13 CLOUD LIQUID WATER: HEMISPHERIC

3.4.5.13.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.13.2	*User & Priority (LO-#)*	Climate-1 NESDIS/OSDPD-1 NESDIS/ORA-3 DoD/USAF-1 Europeans-UA	Climate-1 NESDIS/OSDPD-1 NESDIS/ORA-3 DoD/USAF-1 Europeans-UA
3.4.5.13.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.13.4	*Vertical Resolution*	Total Column	TBD
3.4.5.13.5	*Horizontal Resolution*	2 km	1 km
3.4.5.13.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.13.7	*Measurement Range*	0 - 1 mm	0 - 2 mm
3.4.5.13.8	*Measurement Accuracy*	Day: Greater of 0.1 mm or 25% Night:<50%	Day: Greater of 0.1 mm or 25% Night:<50%
3.4.5.13.9	*Refresh Rate*	30 min	5 min
3.4.5.13.10	*Data Latency*	1 min	1 min
3.4.5.13.11	*Long-term Stability*	TBD	0.005 mm

3.4.5.14 CLOUD LIQUID WATER: MESOSCALE

3.4.5.14.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.14.2	*User & Priority (LO-#)*	OAR/NSSL-1	OAR/NSSL-1
3.4.5.14.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.14.4	*Vertical Resolution*	Total Column	SURFACE - 20 km
3.4.5.14.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.14.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.14.7	*Measurement Range*	0 - 1 mm	0 - 2 mm
3.4.5.14.8	*Measurement Accuracy*	Day: Greater of 0.1 mm or 25% Night:<50%	Day: Greater of 0.1 mm or 25% Night:<50%
3.4.5.14.9	*Refresh Rate*	1 min	1 min
3.4.5.14.10	*Data Latency*	15 min	15 min
3.4.5.14.11	*Long-term Stability*	TBD	TBD

3.4.5.15 CLOUD AND MOISTURE IMAGERY: CONUS

3.4.5.15.1 Definition

The requirement is for:

- All weather, day/night imagery of selected regions
- Low-light imagery - using reflected moonlight - visible near infrared (VNIR) portion of the spectrum, typically 0.4 - 1.5 μm
  Reference: From a USGS table, VIS is 0.4 - 0.7 μm and the NIR is 0.7 - 1.5 μm
- Imagery within the thermal or infrared portion of the spectrum (typically 1.5 μm to 1.0 μm)

Reference: Same as above

- Specialized imagery within the visible portion of the spectrum (typically 0.4 - 0.7 μm)
    - Near, Shortwave Infrared, Water Vapor - 500 mb, Water Vapor - 30 mb, Infrared Window, Infrared "dirty" Window, Infrared CO_2

Specialized imagery is required at sufficient resolution to enable discernment of environmental phenomena (by either manual analysis or automated algorithms) within the visible portion of the spectrum (typically, 0.4 - 0.7 μm). The cloud and moisture imagery shall be able to depict clouds, water vapor, lights from human settlements, fires, gas flares, and heavily lit fishing boats. Environmental phenomena range in size from cloud types and elements to planetary scale (10^7 km^2) weather patterns [*Intergovernmental Panel on Climate Change*]. The cloud and moisture imagery shall provide digital input, through single bands and/or combinations of band/channels, to remote sensing algorithms that produce other environmental measurements, although this does not replace the explicit requirement for retrieval of individual parameters described elsewhere in this document.

Attribute		Threshold	Objective
3.4.5.15.2	*User & Priority (LO-#)*	NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/NCEP/SPC-1 NWS/WFO-1 OAR/AOML/HRD-1 OAR/FSL-3 (Cloud Imagery Only) DoD/USA-1	NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/NCEP/SPC-1 NWS/WFO-1 OAR/AOML/HRD-1 OAR/FSL-3 (Cloud Imagery) DoD/USA-1
3.4.5.15.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.15.4	*Horizontal Resolution*	2 km	0.2 km
3.4.5.15.5	*Mapping Accuracy*	1 km	0.2 km
3.4.5.15.6	*Measurement Accuracy*	TBD	TBD
3.4.5.15.7	*Refresh Rate*	5 min	1 min
3.4.5.15.8	*Data Latency*	1 min	1 min
3.4.5.15.9	*Long-term Stability*	TBD	TBD

3.4.5.16 CLOUD AND MOISTURE IMAGERY: HEMISPHERIC

3.4.5.16.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.16.2	*User & Priority Category*	Climate-1 NESDIS/OSDPD-1 NWS/NCEP/AWC-1 NWS/NCEP/OPC-1 NWS/NCEP/TPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NMAO/Ships-2 NESDIS/ORA-3 DoD/USA-1 DoD/USAF-1 DoD/USN-USMC-1 Europeans - UA	Climate-1 NESDIS/OSDPD-1 NWS/NCEP/AWC-1 NWS/NCEP/OPC-1 NWS/NCEP/TPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NMAO/Ships-2 NESDIS/ORA-3 DoD/USA-1 DoD/USAF-1 DoD/USN-USMC-1 Europeans - UA
3.4.5.16.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.16.4	*Horizontal Resolution*	2 km	0.1 km
3.4.5.16.5	*Mapping Accuracy*	1 km	0.2 km
3.4.5.16.6	*Measurement Accuracy*	TBD	0.01 (Cloud Fraction)
3.4.5.16.7	*Refresh Rate*	15 min	5 min
3.4.5.16.8	*Data Latency*	1 min	1 min
3.4.5.16.9	*Long-term Stability*	TBD	0.003 (Cloud Fraction)

3.4.5.17 CLOUD AND MOISTURE IMAGERY: MESOSCALE

3.4.5.17.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.17.2	*User & Priority (LO-#)*	NWS/WFO-1 OAR/NSSL-1 OAR/AOML/HRD-1 DoD/USA-1	NWS/WFO-1 OAR/NSSL-1 OAR/AOML/HRD-1 DoD/USA-1
3.4.5.17.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.17.4	*Horizontal Resolution*	2 km	0.2 km
3.4.5.17.5	*Mapping Accuracy*	1 km	0.2 km
3.4.5.17.6	*Refresh Rate*	30 sec	TBD
3.4.5.17.7	*Data Latency*	30 sec	TBD
3.4.5.17.8	*Long-term Stability*	TBD	TBD

3.4.5.18 CLOUD OPTICAL DEPTH: CONUS

3.4.5.18.1 Definition

The degree to which a cloud prevents light from passing through it. The vertical optical thickness between the top and bottom of a cloud.

Cloud optical depths are relatively independent of wavelength throughout the visible spectrum, but rise rapidly in the infrared due to absorption by water, and many clouds approximate blackbodies

in the thermal infrared. In the visible portion of the spectrum, the cloud optical depth is almost entirely due to scattering by droplets or crystals, and ranges through orders of magnitude from low values less than 0.1 for thin cirrus to over 1000 for a large cumulonimbus. Cloud optical depths depend directly on the cloud thickness, the liquid or ice water content, and the size distribution of the water droplets or ice crystals. Optical thickness depends upon the physical constitution (crystals, drop, droplets), the form, the concentration of particles, and the vertical extent of the cloud [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.5.18.2	*User & Priority (LO-#)*	OAR/FSL-3	OAR/FSL-3
3.4.5.18.3	*Geographic Coverage*	CONUS - optical depth >1	CONUS
3.4.5.18.4	*Vertical Resolution*	Total Column	TBD
3.4.5.18.5	*Horizontal Resolution*	2 km	1 km
3.4.5.18.6	*Mapping Accuracy*	1 km	TBD
3.4.5.18.7	*Measurement Range*	0.5 - 50	0 - 100
3.4.5.18.8	*Measurement Accuracy*	10%	TBD
3.4.5.18.9	*Refresh Rate*	30 min	15 min
3.4.5.18.10	*Data Latency*	15 min	1 min
3.4.5.18.11	*Long-term Stability*	TBD	TBD

3.4.5.19 CLOUD OPTICAL DEPTH: HEMISPHERIC

3.4.5.19.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.19.2	*User & Priority (LO-#)*	Climate-1 NESDIS/OSDPD-2 NESDIS/ORA-3	Climate-1 NESDIS/OSDPD-2 NESDIS/ORA-3
3.4.5.19.3	*Geographic Coverage*	Full Disk - optical depth >1	Hemispheric
3.4.5.19.4	*Vertical Resolution*	Total Column	1 km
3.4.5.19.5	*Horizontal Resolution*	2 km	1 km
3.4.5.19.6	*Mapping Accuracy*	1 km	0.2 km
3.4.5.19.7	*Measurement Range*	0.5 – 50	0.01 - 100
3.4.5.19.8	*Measurement Accuracy*	10%	2%
3.4.5.19.9	*Refresh Rate*	15 min	5 min
3.4.5.19.10	*Data Latency*	1 min	1 min
3.4.5.19.11	*Long-term Stability*	2%	1%

3.4.5.20 CLOUD PARTICLE SIZE DISTRIBUTION: CONUS

3.4.5.20.1 Definition

The effective radius r_e and effective variance v_e of a single mode particle size distribution. The effective radius is the ratio of the third moment of the size distribution to the second moment. The effective variance characterizes the width of the size distribution. The refresh requirement for the climate products is to provide observations from the satellite nadir-track of any satellite carrying the aerosol polarimeter [*Integrated Operational Requirements Document*].

Attribute		Threshold	Objective
3.4.5.20.2	*User & Priority (LO-#)*	NESDIS/OSDPD-2 NWS/WFO - 2 NWS/NCEP/OPC-3	NESDIS/OSDPD-2 NWS/WFO - 2 NWS/NCEP/OPC-3
3.4.5.20.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.20.4	*Vertical Resolution*	Cloud Top	1 km
3.4.5.20.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.20.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.20.7	*Measurement Range*	0 - 50 µm	2 - 1000 µm
3.4.5.20.8	*Measurement Accuracy*	4 µm	0.5 µm
3.4.5.20.9	*Refresh Rate*	5 min	1 min
3.4.5.20.10	*Data Latency*	1 min	1 min
3.4.5.20.11	*Long-term Stability*	TBD	TBD

3.4.5.21 CLOUD PARTICLE SIZE DISTRIBUTION: HEMISPHERIC

3.4.5.21.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.21.2	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/AWC-1 NESDIS/ORA-3 NWS/NCEP/OPC-3 DoD/USN-USMC-1 DoD/USAF-1 Europeans – UA	Climate-1 NWS/NCEP/AWC-1 NESDIS/ORA-3 NWS/NCEP/OPC-3 DoD/USN-USMC-1 DoD/USAF-1 Europeans – UA
3.4.5.21.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.21.4	*Vertical Resolution*	Cloud Top	TBD
3.4.5.21.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.21.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.21.7	*Measurement Range*	0 - 50 µm	2 - 1000 µm
3.4.5.21.8	*Measurement Accuracy*	4 µm	0.5 µm
3.4.5.21.9	*Refresh Rate*	15 min	15 min
3.4.5.21.10	*Data Latency*	1 min	1 min
3.4.5.21.11	*Long-term Stability*	TBD	TBD

3.4.5.22 CLOUD PARTICLE SIZE DISTRIBUTION: MESOSCALE

3.4.5.22.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.22.2	*User & Priority (LO-#)*	NWS/WFO-2 NWS/NCEP/OPC-3 OAR/NSSL-3 DoD/USA-1	NWS/WFO-2 NWS/NCEP/OPC-3 OAR/NSSL-3 DoD/USA-1
3.4.5.22.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.22.4	*Vertical Resolution*	Cloud Top	TBD
3.4.5.22.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.22.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.22.7	*Measurement Range*	0 - 50 µm	0 - 100 µm
3.4.5.22.8	*Measurement Accuracy*	4 µm	0.5 µm
3.4.5.22.9	*Refresh Rate*	5 min	1 min
3.4.5.22.10	*Data Latency*	1 min	1 min
3.4.5.22.11	*Long-term Stability*	TBD	TBD

3.4.5.23 CLOUD TOP HEIGHT: CONUS

3.4.5.23.1 Definition

The height of the cloud top above local terrain or above mean sea level [*Glossary of Weather and Climate*].

Attribute		Threshold	Objective
3.4.5.23.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-2 OAR/FSL-3	NWS/NCEP/OPC-2 OAR/FSL-3
3.4.5.23.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.23.4	*Vertical Resolution*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	100 m
3.4.5.23.5	*Horizontal Resolution*	10 km	0.5 km
3.4.5.23.6	*Mapping Accuracy*	5 km	0.2 km
3.4.5.23.7	*Measurement Range*	100 m - 300 hPa	100 m - 100 hPa
3.4.5.23.8	*Measurement Accuracy*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	50 m
3.4.5.23.9	*Refresh Rate*	60 min	1 min
3.4.5.23.10	*Data Latency*	3 min	1 min
3.4.5.23.11	*Long-term Stability*	TBD	TBD

3.4.5.24 CLOUD TOP HEIGHT: HEMISPHERIC

3.4.5.24.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.24.2	*User & Priority (LO-#)*	Climate-1 NESDIS/OSDPD-1 NWS/NCEP/OPC-2 NESDIS/ORA-3 DoD/USAF-1 Europeans - UA	Climate-1 NESDIS/OSDPD-1 NWS/NCEP/OPC-2 NESDIS/ORA-3 DoD/USAF-1 Europeans - UA
3.4.5.24.3	*Geographic Coverage*	62˚ LZA	Hemispheric
3.4.5.24.4	*Vertical Resolution*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	0.1 km
3.4.5.24.5	*Horizontal Resolution*	10 km	0.5 km
3.4.5.24.6	*Mapping Accuracy*	5 km	0.2 km
3.4.5.24.7	*Measurement Range*	0 - 15 km	0 - 25 km
3.4.5.24.8	*Measurement Accuracy*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	150 m
3.4.5.24.9	*Refresh Rate*	60 min	5 min
3.4.5.24.10	*Data Latency*	3 min	1 min
3.4.5.24.11	*Long-term Stability*	2%	1%

3.4.5.25 CLOUD TOP HEIGHT: MESOSCALE

3.4.5.25.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.25.2	*User & Priority (LO-#)*	OAR/NSSL-1	OAR/NSSL-1
3.4.5.25.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.25.4	*Vertical Resolution*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	TBD
3.4.5.25.5	*Horizontal Resolution*	4 km	0.5 km
3.4.5.25.6	*Mapping Accuracy*	2 km	0.2 km
3.4.5.25.7	*Measurement Range*	0 - 20 km	0 - 20 km
3.4.5.25.8	*Measurement Accuracy*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	10 - 100 km
3.4.5.25.9	*Refresh Rate*	5 min	1 min
3.4.5.25.10	*Data Latency*	15 min	15 min
3.4.5.25.11	*Long-term Stability*	TBD	TBD

3.4.5.26 CLOUD TOP PHASE: CONUS

3.4.5.26.1 Definition

The state of aggregation of a cloud, for example, solid, liquid, or gas [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.5.26.2	*User & Priority (LO-#)*	NWS/WFO-2 NWS/NCEP/OPC-3 OAR/FSL-3	NWS/WFO-2 NWS/NCEP/OPC-3 OAR/FSL-3
3.4.5.26.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.26.4	*Vertical Resolution*	Cloud Top	TBD
3.4.5.26.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.26.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.26.7	*Measurement Range*	liquid/solid/ supercooled/mixed	TBD
3.4.5.26.8	*Measurement Accuracy*	TBD	TBD
3.4.5.26.9	*Refresh Rate*	5 min	1 min
3.4.5.26.10	*Data Latency*	1 min	1 min
3.4.5.26.11	*Long-term Stability*	TBD	TBD

3.4.5.27 CLOUD TOP PHASE: HEMISPHERIC

3.4.5.27.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.27.2	*User & Priority (LO-#)*	Climate-1 NESDIS/OSDPD-2 NESDIS/ORA-3	Climate-1 NESDIS/OSDPD-2 NESDIS/ORA-3
3.4.5.27.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.27.4	*Vertical Resolution*	Cloud Top	TBD
3.4.5.27.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.27.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.27.7	*Measurement Range*	liquid/solid/ supercooled/mixed	TBD
3.4.5.27.8	*Measurement Accuracy*	TBD	TBD
3.4.5.27.9	*Refresh Rate*	15 min	5 min
3.4.5.27.10	*Data Latency*	1 min	1 min
3.4.5.27.11	*Long-term Stability*	TBD	TBD

3.4.5.28 CLOUD TOP PHASE: MESOSCALE

3.4.5.28.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.28.2	*User & Priority (LO-#)*	NWS/WFO-2 NWS/NCEP/OPC-3 OAR/NSSL-3	NWS/WFO-2 NWS/NCEP/OPC-3 OAR/NSSL-3
3.4.5.28.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.28.4	*Vertical Resolution*	Cloud Top	TBD
3.4.5.28.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.28.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.28.7	*Measurement Range*	liquid/solid/ supercooled/mixed	TBD
3.4.5.28.8	*Measurement Accuracy*	TBD	TBD
3.4.5.28.9	*Refresh Rate*	1 min	1 min
3.4.5.28.10	*Data Latency*	1 min	1 min
3.4.5.28.11	*Long-term Stability*	TBD	TBD

3.4.5.29 CLOUD TOP PRESSURE: CONUS

3.4.5.29.1 Definition

Atmospheric pressure observed at the top of a cloud [*NASA's Global Change Master Directory (GCMD)*].

Attribute		Threshold	Objective
3.4.5.29.2	*User & Priority (LO-#)*	OAR/FSL-3	OAR/FSL-3
3.4.5.29.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.29.4	*Vertical Resolution*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	100 m
3.4.5.29.5	*Horizontal Resolution*	10 km	TBD
3.4.5.29.6	*Mapping Accuracy*	5 km	TBD
3.4.5.29.7	*Measurement Range*	100 m - 300 hPa	100 m - 100 hPa
3.4.5.29.8	*Measurement Accuracy*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	50 m
3.4.5.29.9	*Refresh Rate*	60 min	10 min
3.4.5.29.10	*Data Latency*	10 min	1 min
3.4.5.29.11	*Long-term Stability*	TBD	TBD

3.4.5.30 CLOUD TOP PRESSURE: HEMISPHERIC

3.4.5.30.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.30.2	*User & Priority (LO-#)*	Climate-1 NESDIS/OSDPD-2	Climate-1 NESDIS/OSDPD-2
3.4.5.30.3	*Geographic Coverage*	62˚ LZA	Hemispheric
3.4.5.30.4	*Vertical Resolution*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	1 mb
3.4.5.30.5	*Horizontal Resolution*	10 km	1 km
3.4.5.30.6	*Mapping Accuracy*	5 km	0.2 km
3.4.5.30.7	*Measurement Range*	TBD	TBD
3.4.5.30.8	*Measurement Accuracy*	Sfc-500 mb: 300-500 m 500-300 mb: 1-2 km	15 hPa
3.4.5.30.9	*Refresh Rate*	60 min	5 min
3.4.5.30.10	*Data Latency*	3 min	1 min
3.4.5.30.11	*Long-term Stability*	TBD	3 hPa

3.4.5.31 CLOUD TOP TEMPERATURE: HEMISPHERIC

3.4.5.31.1 Definition

Measurement of temperature at the top of the highest cloud layer as a threshold, at the top of all cloud layers as an objective.

Attribute		Threshold	Objective
3.4.5.31.2	*User & Priority (LO-#)*	Climate/-1 NESDIS/OSDPD -1 NWS/NCEP/TPC - 1 NESDIS/ORA - 3 DoD/USAF - 1	Climate/-1 NESDIS/OSDPD -1 NWS/NCEP/TPC - 1 NESDIS/ORA - 3 DoD/USAF - 1
3.4.5.31.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.31.4	*Vertical Resolution*	At Cloud Tops	4 layers, at Cloud Tops
3.4.5.31.5	*Horizontal Resolution*	2 km	0.2 km
3.4.5.31.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.31.7	*Measurement Range*	180 - 300 K	170 - 310 K
3.4.5.31.8	*Measurement Accuracy*	1 K	0.3 K
3.4.5.31.9	*Refresh Rate*	15 min	5 min
3.4.5.31.10	*Data Latency*	1 min	1 min
3.4.5.31.11	*Long-term Stability*	TBD	0.2 K

3.4.5.32 CLOUD TOP TEMPERATURE: MESOSCALE

3.4.5.32.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.32.2	*User & Priority (LO-#)*	OAR/NSSL-3	OAR/NSSL-3
3.4.5.32.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.32.4	*Vertical Resolution*	At Cloud Tops	TBD
3.4.5.32.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.32.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.32.7	*Measurement Range*	190 - 300 K	190 - 300 K
3.4.5.32.8	*Measurement Accuracy*	0.5 K	0.5 K
3.4.5.32.9	*Refresh Rate*	1 min	1 min
3.4.5.32.10	*Data Latency*	5 min	5 min
3.4.5.32.11	*Long-term Stability*	TBD	TBD

3.4.5.33 CLOUD TYPE: CONUS

3.4.5.33.1 Definition

The main characteristic form of a cloud used in its identification. Also known as cloud genus [*Glossary of Weather and Climate*].

Attribute		Threshold	Objective
3.4.5.33.2	*User & Priority (LO-#)*	OAR/FSL-3 DoD/USA-1	OAR/FSL-3 DoD/USA-1
3.4.5.33.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.33.4	*Vertical Resolution*	TBD	TBD
3.4.5.33.5	*Horizontal Resolution*	2 km	1 km
3.4.5.33.6	*Mapping Accuracy*	1 km	TBD
3.4.5.33.7	*Measurement Range*	7 types	20 types
3.4.5.33.8	*Measurement Accuracy*	TBD	TBD
3.4.5.33.9	*Refresh Rate*	15 min	15 min
3.4.5.33.10	*Data Latency*	10 min	1 min
3.4.5.33.11	*Long-term Stability*	TBD	TBD

3.4.5.34 CLOUD TYPE: HEMISPHERIC

3.4.5.34.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.34.2	*User & Priority (LO-#)*	Climate - 1 NESDIS/ORA - 3 NESDIS/OSDPD - 3 DoD/USN-USMC -1 DoD/USA -1 DoD/USAF-1	Climate - 1 NESDIS/ORA - 3 NESDIS/OSDPD - 3 DoD/USN-USMC -1 DoD/USA -1 DoD/USAF-1
3.4.5.34.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.34.4	*Vertical Resolution*	TBD	TBD
3.4.5.34.5	*Horizontal Resolution*	2 km	0.1 km
3.4.5.34.6	*Mapping Accuracy*	1 km	0.5 km
3.4.5.34.7	*Measurement Range*	7 types	20 types
3.4.5.34.8	*Measurement Accuracy*	TBD	TBD
3.4.5.34.9	*Refresh Rate*	15 min	5 min
3.4.5.34.10	*Data Latency*	1 min	1 min
3.4.5.34.11	*Long-term Stability*	TBD	TBD

3.4.5.35 CLOUD TYPE: MESOSCALE

3.4.5.35.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.35.2	*User & Priority (LO-#)*	DoD/USA-1	DoD/USA-1
3.4.5.35.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.35.4	*Vertical Resolution*	TBD	TBD
3.4.5.35.5	*Horizontal Resolution*	2 km	TBD
3.4.5.35.6	*Mapping Accuracy*	1 km	1 km
3.4.5.35.7	*Measurement Range*	7 types	20 types
3.4.5.35.8	*Measurement Accuracy*	TBD	TBD
3.4.5.35.9	*Refresh Rate*	TBD	15 min
3.4.5.35.10	*Data Latency*	TBD	15 min
3.4.5.35.11	*Long-term Stability*	TBD	TBD

3.4.5.36 CONVECTIVE INITIATION

3.4.5.36.1 Definition

In meteorology, atmospheric (wind) motions that are predominantly vertical, resulting in vertical transport and mixing of atmospheric properties [*Glossary of Weather and Climate*].

Attribute		Threshold	Objective
3.4.5.36.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1	NESDIS/OSDPD-1
3.4.5.36.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.36.4	*Vertical Resolution*	TBD	TBD
3.4.5.36.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.36.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.36.7	*Measurement Range*	TBD	TBD
3.4.5.36.8	*Measurement Accuracy*	TBD	TBD
3.4.5.36.9	*Refresh Rate*	15 min	5 min
3.4.5.36.10	*Data Latency*	3 min	1 min
3.4.5.36.11	*Long-term Stability*	TBD	TBD

3.4.5.37 ENHANCED "V"/OVERSHOOTING TOP DETECTION: CONUS

3.4.5.37.1 Definition

A signature on infrared satellite imagery that depicts a warm, wedge-shaped region stretching from the upshear edge of a thunderstorm anvil, downshear along its long axis [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.5.37.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1 NESDIS/ORA-3	NESDIS/OSDPD-1 NESDIS/ORA-3
3.4.5.37.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.37.4	*Vertical Resolution*	TBD	TBD
3.4.5.37.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.37.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.37.7	*Measurement Range*	0 - 1 Binary (160 - 270 K)	0 - 1 Binary (160 - 270 K Top)
3.4.5.37.8	*Measurement Accuracy*	10 % Detection (1 K Top)	5 % Detection (0.5 K Top)
3.4.5.37.9	*Refresh Rate*	15 min	1 min
3.4.5.37.10	*Data Latency*	5 min	30 sec

3.4.5.38 ENHANCED "V"/OVERSHOOTING TOP DETECTION: MESOSCALE

3.4.5.38.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.38.2	*User & Priority (LO-#)*	OAR/NSSL-2	OAR/NSSL-2
3.4.5.38.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.38.4	*Vertical Resolution*	TBD	TBD
3.4.5.38.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.38.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.38.7	*Measurement Range*	0 - 1	0 - 1
3.4.5.38.8	*Measurement Accuracy*	10%	5%
3.4.5.38.9	*Refresh Rate*	1 min	1 min
3.4.5.38.10	*Data Latency*	5 min	5 min

3.4.5.39 HURRICANE INTENSITY

3.4.5.39.1 Definition

A hurricane is defined as a severe tropical cyclone with maximum 1-minute sustained surface wind speed greater than 64 knots (74 mph or Beaufort force 12) in the North Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and in the Eastern North Pacific off the west coast of Mexico to the International Dateline. Classification of the intensity of hurricane intensity is based on the maximum surface wind speed and the type and extent of damage done by the storm. The wind speed categories are as follows: Category 1: 33 - 42 m/s (65 - 82 knots); Category 2: 43 - 49 m/s (83 - 95 knots); Category 3: 50 - 58 m/s (96 - 113 knots); Category 4: 59 - 69 m/s (114 - 134 knots); and Category 5: 70 m/s (135 knots) and higher [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.5.39.2	*User & Priority (LO-#)*	NESDIS/ORA-3 NESDIS/OSDPD-1	NESDIS/ORA-3 NESDIS/OSDPD-1
3.4.5.39.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.39.4	*Vertical Resolution*	TBD	TBD
3.4.5.39.5	*Horizontal Resolution*	2 km	1 km
3.4.5.39.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.39.7	*Measurement Range*	TBD	TBD
3.4.5.39.8	*Measurement Accuracy*	5 m/s	TBD
3.4.5.39.9	*Refresh Rate*	30 min	15 min
3.4.5.39.10	*Data Latency*	1 min	1 min

3.4.5.40 IMAGERY: ALL-WEATHER/DAY-NIGHT: HEMISPHERIC

3.4.5.40.1 Definition

All weather day/night imagery of selected regions. Imagery shall allow discernment of environmental phenomena, including sea ice (by either manual analysis or automated algorithms) and provide digital input to remote sensing algorithms which produce other environmental parameters [*Integrated Operational Requirements Document*].

Attribute		Threshold	Objective
3.4.5.40.2	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.4.5.40.3	*Geographic Coverage*	Full Disk - Clear and Above Cloud Regions Only	Hemispheric
3.4.5.40.4	*Horizontal Resolution*	2 km	0.1 km
3.4.5.40.5	*Mapping Accuracy*	1.0 km	0.5 km
3.4.5.40.6	*Measurement Range*	TBD	TBD
3.4.5.40.7	*Measurement Accuracy*	TBD	TBD
3.4.5.40.8	*Refresh Rate*	TBD	60 min
3.4.5.40.9	*Data Latency*	TBD	15 min

3.4.5.41 LIGHTNING DETECTION: CONUS

3.4.5.41.1 Definition

The location of air-to-air and air-to-ground lightning strikes.

Attribute		Threshold	Objective
3.4.5.41.2	*User & Priority (LO-#)*	NESDIS/OSDPD/SSD - 1 NWS/NCEP/AWC-1 NWS/NCEP/CPC-1 NWS/NCEP/OPC-1 NESDIS/ORA - UA NWS/WFO - 1	NESDIS/OSDPD/SSD - 1 NWS/NCEP/AWC-1 NWS/NCEP/CPC-1 NWS/NCEP/OPC-1 NESDIS/ORA - UA NWS/WFO - 1
3.4.5.41.3	*Geographic Coverage*	CONUS	CONUS
3.4.5.41.4	*Vertical Resolution*	Surface to cloud top	Surface to cloud top
3.4.5.41.5	*Horizontal Resolution*	10 km	500 m
3.4.5.41.6	*Mapping Accuracy*	1 km	100 m
3.4.5.41.7	*Measurement Range*	Real time	Real time
3.4.5.41.8	*Measurement Accuracy*	70% - 90% total strikes detection	99% total strikes detection
3.4.5.41.9	*Refresh Rate*	continuous	continuous
3.4.5.41.10	*Data Latency*	1 min	<10 sec

3.4.5.42 LIGHTNING DETECTION: HEMISPHERIC

3.4.5.42.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.42.2	*User & Priority (LO-#)*	NESDIS/OSDPD/SSD-1 NWS/NCEP/AWC-1 NWS/NCEP/CPC-1 NWS/NCEP/OPC-1 NWS/WFO - 1 DoD/USAF-1	NESDIS/OSDPD/SSD-1 NWS/NCEP/AWC-1 NWS/NCEP/CPC-1 NWS/NCEP/OPC-1 NWS/WFO - 1 DoD/USAF-1
3.4.5.42.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.42.4	*Vertical Resolution*	Surface to cloud top	Surface to cloud top
3.4.5.42.5	*Horizontal Resolution*	10 km	500 m
3.4.5.42.6	*Mapping Accuracy*	1 km	100 m
3.4.5.42.7	*Measurement Range*	Real time	Real time
3.4.5.42.8	*Measurement Accuracy*	70% - 90% total strikes detection	99% total strikes detection
3.4.5.42.9	*Refresh Rate*	continuous	continuous
3.4.5.42.10	*Data Latency*	1 min	<10 sec

3.4.5.43 LIGHTNING DETECTION: MESOSCALE

3.4.5.43.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.43.2	*User & Priority (LO-#)*	OAR/NSSL-1	OAR/NSSL-1
3.4.5.43.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.43.4	*Vertical Resolution*	Surface to cloud top	Surface to cloud top
3.4.5.43.5	*Horizontal Resolution*	10 km	0.5 km
3.4.5.43.6	*Mapping Accuracy*	1 km	0.2 km
3.4.5.43.7	*Measurement Range*	0 - 1 Binary	Real time
3.4.5.43.8	*Measurement Accuracy*	TBD	TBD
3.4.5.43.9	*Refresh Rate*	continuous	continuous
3.4.5.43.10	*Data Latency*	1 min	1 min

3.4.5.44 LOW CLOUD AND FOG

3.4.5.44.1 Definition

Low cloud is defined as clouds with a mean height level which is between the earth's surface and 6,500 feet. Fog is defined as clouds in contact with the earth's surface [*Glossary of Weather and Climate*].

Attribute		Threshold	Objective
3.4.5.44.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1 NESDIS/ORA-3	NESDIS/OSDPD-1 NESDIS/ORA-3
3.4.5.44.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.5.44.4	*Vertical Resolution*	0.5 km (depth)	0.1 km
3.4.5.44.5	*Horizontal Resolution*	2 km	1 km
3.4.5.44.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.44.7	*Measurement Range*	Fog/No Fog	Fog/No Fog
3.4.5.44.8	*Measurement Accuracy*	70% Detection	90% Detection
3.4.5.44.9	*Refresh Rate*	15 min	15 min
3.4.5.44.10	*Data Latency*	1 min	1 min

3.4.5.45 TURBULENCE: HEMISPHERIC

3.4.5.45.1 Definition

A state of fluid flow in which the instantaneous (wind) velocities exhibit irregular and apparently random fluctuations so that in practice only statistical properties can be recognized and subjected to analysis [*Glossary of Weather and Climate*].

Attribute		Threshold	Objective
3.4.5.45.2	*User & Priority (LO-#)*	NWS/NCEP/AWC-1 NESDIS/ORA-3 DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1	NWS/NCEP/AWC-1 NESDIS/ORA-3 DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1
3.4.5.45.3	*Geographic Coverage*	Full Disk	Global
3.4.5.45.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb + : 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb + : 2 km
3.4.5.45.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.45.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.45.7	*Measurement Range*	Binary moderate or greater (over 100 m - 4 km)	None thru Severe (none, light, moderate, severe)
3.4.5.45.8	*Measurement Accuracy*	TBD	TBD
3.4.5.45.9	*Refresh Rate*	15 min	5 min
3.4.5.45.10	*Data Latency*	1 min	1 min

3.4.5.46 TURBULENCE: MESOSCALE

3.4.5.46.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.46.2	*User & Priority (LO-#)*	OAR/NSSL-3	OAR/NSSL-3
3.4.5.46.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.5.46.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb + : 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb + : 2 km
3.4.5.46.5	*Horizontal Resolution*	2 km	0.5 km
3.4.5.46.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.5.46.7	*Measurement Range*	TBD	TBD
3.4.5.46.8	*Measurement Accuracy*	TBD	TBD
3.4.5.46.9	*Refresh Rate*	5 min	1 min
3.4.5.46.10	*Data Latency*	5 min	5 min

3.4.5.47 VISIBILITY: COASTAL

3.4.5.47.1 Definition

Visibility is the clarity with which an object may be seen. It is the greatest distance in a given direction at which it is just possible to see and identify with the unaided eye:

1) in the daytime a prominent dark object against the sky at the horizon, and
2) at night, a known, preferably unfocused, moderately intense light source. [*Glossary of Meteorology*]

Attribute		Threshold	Objective
3.4.5.47.2	*User & Priority (LO-#)*	NOS/OCS-2 NOS/ORR-2 NOS/CO-OPS-2	NOS/OCS-2 NOS/ORR-2 NOS/CO-OPS-2
3.4.5.47.3	*Geographic Coverage*	U.S. navigable waters thru EEZ	U.S. navigable waters thru EEZ
3.4.5.47.4	*Vertical Resolution*	TBD	0 - 150 ft
3.4.5.47.5	*Horizontal Resolution*	3 km	0.8 km
3.4.5.47.6	*Mapping Accuracy*	<3 km	<0.8 km
3.4.5.47.7	*Measurement Range*	0 - 2 miles	0 - 10 miles
3.4.5.47.8	*Measurement Accuracy*	TBD	400 m
3.4.5.47.9	*Refresh Rate*	180 min	60 min
3.4.5.47.10	*Data Latency*	15 min	15 min

3.4.5.48 VISIBILITY: HEMISPHERIC

3.4.5.48.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.5.48.2	*User & Priority (LO-#)*	DoD/USN-USMC-1 DoD/USAF-1	DoD/USN-USMC-1 DoD/USAF-1
3.4.5.48.3	*Geographic Coverage*	Full Disk	Global
3.4.5.48.4	*Vertical Resolution*	TBD	Sfc-4.5 km: 150 m >4.5 km: 300 m
3.4.5.48.5	*Horizontal Resolution*	10 km	10 km
3.4.5.48.6	*Mapping Accuracy*	TBD	2 km
3.4.5.48.7	*Measurement Range*	0 - 30 km	0 - 30 km
3.4.5.48.8	*Measurement Accuracy*	TBD	± 1 km
3.4.5.48.9	*Refresh Rate*	60 min	60 min
3.4.5.48.10	*Data Latency*	15 min	15 min

3.4.6 Performance Characteristics: Atmosphere / Precipitation

3.4.6.1 PROBABILITY OF RAINFALL

3.4.6.1.1 Definition

The probability (or chance) of rainfall is the likelihood of occurrence, expressed as a percentage, that measurable rainfall (0.01 inch or more) will occur at any point within a specified forecast area over a specific period of time.

Attribute		Threshold	Objective
3.4.6.1.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1	NESDIS/OSDPD-1
3.4.6.1.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.6.1.4	*Vertical Resolution*	TBD	TBD
3.4.6.1.5	*Horizontal Resolution*	2 km	0.5 km
3.4.6.1.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.6.1.7	*Measurement Range*	0% - 100%	0% - 100%
3.4.6.1.8	*Measurement Accuracy*	25%	10%
3.4.6.1.9	*Refresh Rate*	15 min	1 min
3.4.6.1.10	*Data Latency*	5 min	3 min

3.4.6.2 RAINFALL POTENTIAL

3.4.6.2.1 Definition

Assessment of rainfall potential (more than 12 hours from landfall) in terms of area accumulation (maximum amount) and distribution of rainfall (location).

Attribute		Threshold	Objective
3.4.6.2.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1	NESDIS/OSDPD-1
3.4.6.2.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.6.2.4	*Vertical Resolution*	TBD	TBD
3.4.6.2.5	*Horizontal Resolution*	2 km	0.5 km
3.4.6.2.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.6.2.7	*Measurement Range*	0 - 100 mm/hr	0 - 100 mm/hr
3.4.6.2.8	*Measurement Accuracy*	5 mm/hr	2 mm/hr
3.4.6.2.9	*Refresh Rate*	15 min	1 min
3.4.6.2.10	*Data Latency*	5 min	3 min

3.4.6.3 RAINFALL RATE/QPE

3.4.6.3.1 Definition

Rainfall rate and Quantitative Precipitation Estimation (QPE). QPE is a forecast of precipitation amount specifically in depth units (e.g., millimeters).

Attribute		Threshold	Objective
3.4.6.3.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1 NESDIS/ORA-3 Hydrology Program - UA Europeans - UA	NESDIS/OSDPD-1 NESDIS/ORA-3 Hydrology Program - UA Europeans - UA
3.4.6.3.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.6.3.4	*Vertical Resolution*	TBD	TBD
3.4.6.3.5	*Horizontal Resolution*	2 km	0.5 km
3.4.6.3.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.6.3.7	*Measurement Range*	0 - 100 mm/hr	0 - 50 mm/15 minutes
3.4.6.3.8	*Measurement Accuracy*	2 mm/hr	1 mm/hr
3.4.6.3.9	*Refresh Rate*	15 min	1 min
3.4.6.3.10	*Data Latency*	1 min	1 min

3.4.7 Performance Characteristics: Atmosphere / Profiles

3.4.7.1 ATMOSPHERIC VERTICAL MOISTURE PROFILE: CONUS

3.4.7.1.1 Definition

Water vapor mixing ratio profile throughout the troposphere (Units: g kg^{-1}).

Attribute		Threshold	Objective
3.4.7.1.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 Hydrology Program - UA DoD/USA-1	NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 Hydrology Program - UA DoD/USA-1
3.4.7.1.3	*Geographic Coverage*	62^{o} LZA - Clear and Above Cloud Regions Only	CONUS - All Weather
3.4.7.1.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km
3.4.7.1.5	*Horizontal Resolution*	10 km	1 km
3.4.7.1.6	*Mapping Accuracy*	5 km	0.2 km
3.4.7.1.7	*Measurement Range*	0 – 100%	0 – 100%
3.4.7.1.8	*Measurement Accuracy*	Surface - 500 mb: 10% 500-300 mb: 10% 300-100 mb: 20%	Surface - 500 mb: 5% 500-300 mb: 5% 300-100 mb: 10%
3.4.7.1.9	*Refresh Rate*	60 min	5 min
3.4.7.1.10	*Data Latency*	3 min	1 min

3.4.7.2 ATMOSPHERIC VERTICAL MOISTURE PROFILE: HEMISPHERIC

3.4.7.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.2.2	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 DoD/USA-1 DoD/USAF - 1 DoD/USN-USMC-1 Europeans - UA	Climate-1 NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 DoD/USA-1 DoD/USAF - 1 DoD/USN-USMC-1 Europeans - UA
3.4.7.2.3	*Geographic Coverage*	62^{o} LZA - Clear and Above Cloud Regions Only	Hemispheric - All Weather
3.4.7.2.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km
3.4.7.2.5	*Horizontal Resolution*	10 km	2 km
3.4.7.2.6	*Mapping Accuracy*	5 km	0.5 km
3.4.7.2.7	*Measurement Range*	0 – 100%	0 – 100%
3.4.7.2.8	*Measurement Accuracy*	Surface-500 mb: 10% 500-300 mb: 10% 300-100 mb: 20%	Surface-500 mb: 5% 500-300 mb: 5% 300-100 mb: 10%
3.4.7.2.9	*Refresh Rate*	60 min	15 min
3.4.7.2.10	*Data Latency*	3 min	1 min
3.4.7.2.11	*Long-term Stability*	TBD	0.26 %

3.4.7.3 ATMOSPHERIC VERTICAL MOISTURE PROFILE: MESOSCALE

3.4.7.3.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.3.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/AOML/HRD-1 OAR/NSSL-2 DoD/USA-1	NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/AOML/HRD-1 OAR/NSSL-2 DoD/USA-1
3.4.7.3.3	*Geographic Coverage*	M - Clear and Above Cloud Regions Only	Mesoscale - All Weather
3.4.7.3.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km
3.4.7.3.5	*Horizontal Resolution*	4 km	2 km
3.4.7.3.6	*Mapping Accuracy*	2 km	0.5 km
3.4.7.3.7	*Measurement Range*	0 – 100%	0 – 100%
3.4.7.3.8	*Measurement Accuracy*	Surface-500 mb: 10% 500-300 mb: 10% 300-100 mb: 20%	Surface-500 mb: 5% 500-300 mb: 5% 300-100 mb: 10%
3.4.7.3.9	*Refresh Rate*	15 min	15 min
3.4.7.3.10	*Data Latency*	3 min	1 min

3.4.7.4 ATMOSPHERIC VERTICAL TEMPERATURE PROFILE: CONUS

3.4.7.4.1 Definition

Sampling of temperature at stated intervals throughout the atmosphere.

Attribute		Threshold	Objective
3.4.7.4.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NWS/WFO - 1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 DoD/USA-1	NWS/NCEP/OPC-1 NWS/WFO - 1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 DoD/USA-1
3.4.7.4.3	*Geographic Coverage*	62^{o} LZA / Clear and Above Cloud Regions Only	CONUS - All Weather
3.4.7.4.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+: 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb+: 2 km
3.4.7.4.5	*Horizontal Resolution*	10 km	1 km
3.4.7.4.6	*Mapping Accuracy*	5 km	0.2 km
3.4.7.4.7	*Measurement Range*	180 - 320 K	180 - 320 K
3.4.7.4.8	*Measurement Accuracy*	1 K	0.5 K
3.4.7.4.9	*Refresh Rate*	60 min	5 min
3.4.7.4.10	*Data Latency*	3 min	1 min

3.4.7.5 ATMOSPHERIC VERTICAL TEMPERATURE PROFILE: HEMISPHERIC

3.4.7.5.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.5.2	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 NWS/WFO - 1 NESDIS/OSDPD-2 DoD/USN-USMC-1 Hydrology Program - UA DoD/USA-1 DoD/USAF-1 Europeans - UA	Climate-1 NWS/NCEP/OPC-1 NWS/WFO - 1 NESDIS/OSDPD-2 DoD/USN-USMC-1 Hydrology Program - UA DoD/USA-1 DoD/USAF-1 Europeans - UA
3.4.7.5.3	*Geographic Coverage*	62^{o} LZA / Clear and Above Cloud Regions Only	Hemispheric - All Weather
3.4.7.5.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+: 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb+: 2 km
3.4.7.5.5	*Horizontal Resolution*	10 km	2 km
3.4.7.5.6	*Mapping Accuracy*	5 km	0.5 km
3.4.7.5.7	*Measurement Range*	203 - 320 K	175 - 325 K
3.4.7.5.8	*Measurement Accuracy*	1 K	0.5 K
3.4.7.5.9	*Refresh Rate*	60 min	15 min
3.4.7.5.10	*Data Latency*	3 min	1 min
3.4.7.5.11	*Long-term Stability*	TBD	Troposphere: 0.04 K Stratosphere: 0.08 K

3.4.7.6 ATMOSPHERIC VERTICAL TEMPERATURE PROFILE: MESOSCALE

3.4.7.6.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.6.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/NSSL-2 DoD/USA-1	NWS/NCEP/OPC-1 NWS/WFO - 1 OAR/NSSL-2 DoD/USA-1
3.4.7.6.3	*Geographic Coverage*	Mesoscale / Clear and Above Cloud Regions Only	Mesoscale - All Weather
3.4.7.6.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+: 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb+: 2 km
3.4.7.6.5	*Horizontal Resolution*	4 km	2 km
3.4.7.6.6	*Mapping Accuracy*	2 km	0.5 km
3.4.7.6.7	*Measurement Range*	190 - 314 K	210 - 320 K
3.4.7.6.8	*Measurement Accuracy*	1 K	0.5 K
3.4.7.6.9	*Refresh Rate*	15 min	15 min
3.4.7.6.10	*Data Latency*	3 min	1 min

3.4.7.7 CAPPING INVERSION INFORMATION: CONUS

3.4.7.7.1 Definition

A layer of relatively warm air aloft (usually less than 1 km above the ground) which suppresses or delays the development of thunderstorms

Attribute		Threshold	Objective
3.4.7.7.2	*User & Priority (LO-#)*	NWS/NCEP/AWC-1 NESDIS/OSDPD-2	NWS/NCEP/AWC-1 NESDIS/OSDPD-2
3.4.7.7.3	*Geographic Coverage*	62^{o} LZA / Clear and Above Cloud Regions Only	CONUS - All Weather
3.4.7.7.4	*Vertical Resolution*	Sfc-500 mb: 500 m	Sfc-500 mb: 300 m
3.4.7.7.5	*Horizontal Resolution*	10 km	2 km
3.4.7.7.6	*Mapping Accuracy*	4 km	0.5 km
3.4.7.7.7	*Measurement Range*	T: 210-300K Td: 210-300K Hgt: Sfc-650mb	T: 210-300K Td: 210-300K Hgt: Sfc-650mb
3.4.7.7.8	*Measurement Accuracy*	T: 10K Td: 10K Hgt: 150-250mb	T: 10K Td: 10K Hgt: 150-250mb
3.4.7.7.9	*Refresh Rate*	60 min	5 min
3.4.7.7.10	*Data Latency*	3 min	1 min

3.4.7.8 CAPPING INVERSION: MESOSCALE

3.4.7.8.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.8.2	*User & Priority (LO-#)*	OAR/NSSL-1	OAR/NSSL-1
3.4.7.8.3	*Geographic Coverage*	Mesoscale / Clear and Above Cloud Regions Only	Mesoscale - All Weather
3.4.7.8.4	*Vertical Resolution*	Sfc-500 mb	Sfc-500 mb
3.4.7.8.5	*Horizontal Resolution*	4 km	2 km
3.4.7.8.6	*Mapping Accuracy*	2 km	0.5 km
3.4.7.8.7	*Measurement Range*	0 - 20 K (delta T & Td)	0 - 20 K (delta T & Td)
3.4.7.8.8	*Measurement Accuracy*	0.5 K	0.5 K
3.4.7.8.9	*Refresh Rate*	15 min	5 min
3.4.7.8.10	*Data Latency*	3 min	3 min

3.4.7.9 DERIVED STABILITY INDICES: CONUS

3.4.7.9.1 Definition

Lifted Index (LI) (Degrees Celsius): The Lifted Index is calculated by lifting (frontal, orographic, upper air dynamics, etc.) a parcel of air dry adiabatically while conserving moisture until it reaches saturation. At that point the parcel is lifted moist adiabatically up to 500 mb. The Lifted Index is the ambient air temperature minus the lifted parcel temperature at 500 mb.

Convective Available Potential Energy (CAPE, Joules/kg): Convective Available Potential Energy, a measure of the cumulative buoyancy of a parcel as it rises, in units of Joules per kilogram. CAPE values larger than 1000 J/kg represent moderate amounts of atmospheric potential energy. Values exceeding 3000 J/kg are indicative of very large amounts of potential energy, and are often associated with strong/severe weather. Graphically, the CAPE is the positively buoyant area (shaded purple) on the skew-t diagram

Total Totals Index (TT): The Total Totals Index is computed using discreet pressure level information and is indicative of severe weather potential. Its formula is: TT=(T850+TD850)-2(T500). Generally, TT values below 40-45 are indicators of little or no thunderstorm activity, while values exceeding 55 in the Eastern and Central United States or 65 in the Western United States are indicators of considerable severe weather, including the potential for tornadic activity.

Showalter Index (SI): The SI is a parcel-based index, calculated in the same manner as the Lifted Index, using a parcel at 850 mb. That is, the 850 mb parcel is lifted to saturation, then moist adiabatically to 500 mb. The difference between the parcel and environment at 500 mb is the Showalter Index.

K index (KI): The K-Index is a simple index using data from discreet pressure levels, instead of a lifted parcel. It is based on vertical temperature changes, moisture content of the lower atmosphere, and the vertical extent of the moist layer. The higher the K-Index the more conducive the atmosphere is to convection. The formula for KI is:

KI=(T850 mb-T500 mb) + [(TD850 mb - (T700 mb - TD700 mb)] where:

T=Temperature

TD=Dewpoint temperature.

Attribute		Threshold	Objective
3.4.7.9.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1	NESDIS/OSDPD-1
3.4.7.9.3	*Geographic Coverage*	CONUS	CONUS
3.4.7.9.4	*Vertical Resolution*	TBD	TBD
3.4.7.9.5	*Horizontal Resolution*	4 km	2 km
3.4.7.9.6	*Mapping Accuracy*	1 km	0.5 km
3.4.7.9.7	*Measurement Range*	TBD	TBD
3.4.7.9.8	*Measurement Accuracy*	TBD	TBD
3.4.7.9.9	*Refresh Rate*	30 min	15 min
3.4.7.9.10	*Data Latency*	3 min	1 min

3.4.7.10 DERIVED STABILITY INDICES: MESOSCALE

3.4.7.10.1 Definition

See above, 3.4.7.9 Derived Stability Indices: CONUS.

Attribute		Threshold	Objective
3.4.7.10.2	*User & Priority (LO-#)*	OAR/NSSL-1	OAR/NSSL-1
3.4.7.10.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.7.10.4	*Vertical Resolution*	TBD	TBD
3.4.7.10.5	*Horizontal Resolution*	2 km	2 km
3.4.7.10.6	*Mapping Accuracy*	1.0 km	0.5 km
3.4.7.10.7	*Measurement Range*	0-5000 J/kg	0-5000 J/kg
3.4.7.10.8	*Measurement Accuracy*	10%	5%
3.4.7.10.9	*Refresh Rate*	15 min	5 min
3.4.7.10.10	*Data Latency*	15 min	15 min

3.4.7.11 MOISTURE FLUX: CONUS

3.4.7.11.1 Definition

Refers to net surface flux over oceans (including ice covered). The components of heat flux are longwave/shortwave radiation, latent heat flux, and sensible heat flux.

Heat Flux. A quantity measured according to the formula $B=\lambda\ dT/dz$, where λ is the thermal conductivity of the medium (i.e., soil, air) that the moisture (or heat) is moving through. This may be expressed as flux per unit area for heat or moisture [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.7.11.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-1 NESDIS/OSDPD-2 NWS/WFO-2 NWS/NCEP/OPC-3	NWS/NCEP/EMC-1 NESDIS/OSDPD-2 NWS/WFO-2 NWS/NCEP/OPC-3
3.4.7.11.3	*Geographic Coverage*	62° LZA / Clear and Above Cloud Regions Only	CONUS - All Weather
3.4.7.11.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+: 3 km	1 km
3.4.7.11.5	*Horizontal Resolution*	10 km	2 km
3.4.7.11.6	*Mapping Accuracy*	5 km	0.5 km
3.4.7.11.7	*Measurement Range*	0 – 20 g/kg/h	0 – 20 g/kg/h
3.4.7.11.8	*Measurement Accuracy*	10%	5%
3.4.7.11.9	*Refresh Rate*	60 min	15 min
3.4.7.11.10	*Data Latency*	3 min	1 min

3.4.7.12 MOISTURE FLUX: HEMISPHERIC

3.4.7.12.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.12.2	*User & Priority (LO-#)*	NESDIS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3	NESDIS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3
3.4.7.12.3	*Geographic Coverage*	62° LZA / Clear and Above Cloud Regions Only	Hemispheric - All Weather
3.4.7.12.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+: 3 km	1 km
3.4.7.12.5	*Horizontal Resolution*	10 km	2 km
3.4.7.12.6	*Mapping Accuracy*	5 km	0.5 km
3.4.7.12.7	*Measurement Range*	0 – 20 g/kg/h	0 – 20 g/kg/h
3.4.7.12.8	*Measurement Accuracy*	10%	5%
3.4.7.12.9	*Refresh Rate*	60 min	15 min
3.4.7.12.10	*Data Latency*	3 min	1 min

3.4.7.13 MOISTURE FLUX: MESOSCALE

3.4.7.13.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.13.2	*User & Priority (LO-#)*	NESDIS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3 OAR/NSSL-2	NESDIS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3 OAR/NSSL-2
3.4.7.13.3	*Geographic Coverage*	Mesoscale / Clear and Above Cloud Regions Only	Mesoscale - All Weather
3.4.7.13.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+: 3 km	1 km
3.4.7.13.5	*Horizontal Resolution*	4 km	2 km
3.4.7.13.6	*Mapping Accuracy*	2 km	0.5 km
3.4.7.13.7	*Measurement Range*	0 – 20 g/kg/h	0 – 20 g/kg/h
3.4.7.13.8	*Measurement Accuracy*	10%	5%
3.4.7.13.9	*Refresh Rate*	15 min	5 min
3.4.7.13.10	*Data Latency*	3 min	1 min

3.4.7.14 PRESSURE PROFILE: MESOSCALE

3.4.7.14.1 Definition

Vertical profile of the pressure exerted by the atmosphere as a consequence of gravitational attraction exerted upon the "column" of air lying directly above the point in question [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.7.14.2	*User & Priority (LO-#)*	DoD/USA-1	DoD/USA-1
3.4.7.14.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.7.14.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+: 3 km	≤ 3 km: 30 m >3 km: 300 m
3.4.7.14.5	*Horizontal Resolution*	TBD	25 km
3.4.7.14.6	*Mapping Accuracy*	TBD	10 km
3.4.7.14.7	*Measurement Range*	TBD	10 - 1030 mb
3.4.7.14.8	*Measurement Accuracy*	TBD	± 2.5 %
3.4.7.14.9	*Refresh Rate*	TBD	15 min
3.4.7.14.10	*Data Latency*	TBD	10 min

3.4.7.15 TOTAL PRECIPITABLE WATER: HEMISPHERIC

3.4.7.15.1 Definition

The total atmospheric water vapor contained in a vertical column of unit cross-sectional area extending between any two specified levels, commonly expressed in terms of the height to which that water substance would stand if completely condensed and collected in a vessel of the same unit cross section [*Glossary of Weather and Climate*].

Attribute		Threshold	Objective
3.4.7.15.2	*User & Priority (LO-#)*	Climate-1 DoD/USAF - 1 Europeans - UA	Climate-1 DoD/USAF - 1 Europeans - UA
3.4.7.15.3	*Geographic Coverage*	62^{o} LZA	Hemispheric
3.4.7.15.4	*Vertical Resolution*	TBD	TBD
3.4.7.15.5	*Horizontal Resolution*	100 km	25 km
3.4.7.15.6	*Mapping Accuracy*	TBD	TBD
3.4.7.15.7	*Measurement Range*	TBD	TBD
3.4.7.15.8	*Measurement Accuracy*	TBD	TBD
3.4.7.15.9	*Refresh Rate*	60 min	15 min
3.4.7.15.10	*Data Latency*	TBD	TBD
3.4.7.15.11	*Long-term Stability*	TBD	TBD

3.4.7.16 TOTAL WATER CONTENT: CONUS

3.4.7.16.1 Definition

Measure of moisture in a given volume of the atmosphere. The requirements below apply under both clear and cloudy conditions. Total water content is defined as the water vapor, liquid water, and cloud ice liquid equivalent in specified segments of a vertical column of the atmosphere.

Attribute		Threshold	Objective
3.4.7.16.2	*User & Priority (LO-#)*	OAR/AOML/HRD-1 NWS/NCEP/OPC-2 OAR/FSL-3 DoD/USA-1	OAR/AOML/HRD-1 NWS/NCEP/OPC-2 OAR/FSL-3 DoD/USA-1
3.4.7.16.3	*Geographic Coverage*	CONUS	CONUS - All Weather
3.4.7.16.4	*Vertical Resolution*	Surface - Top of Atmosphere (TOA)	Surface - Top of Atmosphere (TOA)
3.4.7.16.5	*Horizontal Resolution*	10 km	0.5 km
3.4.7.16.6	*Mapping Accuracy*	5 km	0.2 km
3.4.7.16.7	*Measurement Range*	0 - 100 mm	0 - 100 mm
3.4.7.16.8	*Measurement Accuracy*	TBD	1 mm
3.4.7.16.9	*Refresh Rate*	60 min	1 min
3.4.7.16.10	*Data Latency*	3 min	1 min

3.4.7.17 TOTAL WATER CONTENT: HEMISPHERIC

3.4.7.17.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.17.2	*User & Priority (LO-#)*	Climate-1 NESDIS/OSDPD-1 NWS/NCEP/AWC-1 NWS/NCEP/OPC-2 OAR/AOML/HRD-1 DoD/USN-USMC-1 DoD/USAF-1 Europeans - UA	Climate-1 NESDIS/OSDPD-1 NWS/NCEP/AWC-1 NWS/NCEP/OPC-2 OAR/AOML/HRD-1 DoD/USN-USMC-1 DoD/USAF-1 Europeans - UA
3.4.7.17.3	*Geographic Coverage*	62^{o} LZA- Clear and Above Cloud Regions Only	Hemispheric - All Weather
3.4.7.17.4	*Vertical Resolution*	Surface - Top of Atmosphere (TOA)	Surface - Top of Atmosphere (TOA)
3.4.7.17.5	*Horizontal Resolution*	10 km	0.5 km
3.4.7.17.6	*Mapping Accuracy*	5 km	0.2 km
3.4.7.17.7	*Measurement Range*	0 - 100 mm	0 - 100 mm
3.4.7.17.8	*Measurement Accuracy*	TBD	1 mm
3.4.7.17.9	*Refresh Rate*	60 min	15 min
3.4.7.17.10	*Data Latency*	3 min	1 min
3.4.7.17.11	*Long-term Stability*	TBD	TBD

3.4.7.18 TOTAL WATER CONTENT: MESOSCALE

3.4.7.18.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.7.18.2	*User & Priority (LO-#)*	OAR/NSSL-1 OAR/AOML/HRD-1 DoD/USA-1	OAR/NSSL-1 OAR/AOML/HRD-1 DoD/USA-1
3.4.7.18.3	*Geographic Coverage*	Mesoscale - Clear and Above Cloud Regions Only	Mesoscale - All Weather
3.4.7.18.4	*Vertical Resolution*	Surface - Top of Atmosphere (TOA)	Surface - Top of Atmosphere (TOA)
3.4.7.18.5	*Horizontal Resolution*	4 km	0.5 km
3.4.7.18.6	*Mapping Accuracy*	2 km	0.2 km
3.4.7.18.7	*Measurement Range*	0 - 100 mm	0 - 100 mm
3.4.7.18.8	*Measurement Accuracy*	TBD	1 mm
3.4.7.18.9	*Refresh Rate*	5 min	1 min
3.4.7.18.10	*Data Latency*	5 min	5 min

3.4.8 Performance Characteristics: Atmosphere / Radiances

3.4.8.1 CLEAR SKY MASKS: CONUS

3.4.8.1.1 Definition

Confidence that an unobstructed view of the earth's surface is observed. An indication of shadows affecting the scene is also provided. Clear Sky Mask is a delineation of all absolutely cloud-free pixels in a satellite scene with a high confidence. At a minimum, three different categories are delineated: 'cloud free,' 'partially cloudy' and 'cloud filled.'

Attribute		Threshold	Objective
3.4.8.1.2	*User & Priority (LO-#)*	NESDIS/ORA-3	NESDIS/ORA-3
3.4.8.1.3	*Geographic Coverage*	CONUS	CONUS
3.4.8.1.4	*Vertical Resolution*	TBD	TBD
3.4.8.1.5	*Horizontal Resolution*	2 km	TBD
3.4.8.1.6	*Mapping Accuracy*	1 km	TBD
3.4.8.1.7	*Measurement Range*	0 – 1 Binary	0 – 1 Binary
3.4.8.1.8	*Measurement Accuracy*	10%	5%
3.4.8.1.9	*Refresh Rate*	15 min	TBD
3.4.8.1.10	*Data Latency*	15 min	TBD

3.4.8.2 CLEAR SKY MASKS: HEMISPHERIC

3.4.8.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.8.2.2	*User & Priority (LO-#)*	NESDIS/ORA-3	NESDIS/ORA-3
3.4.8.2.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.8.2.4	*Vertical Resolution*	TBD	TBD
3.4.8.2.5	*Horizontal Resolution*	2 km	TBD
3.4.8.2.6	*Mapping Accuracy*	1 km	TBD
3.4.8.2.7	*Measurement Range*	0 – 1 Binary	0 – 1 Binary
3.4.8.2.8	*Measurement Accuracy*	10%	5%
3.4.8.2.9	*Refresh Rate*	15 min	TBD
3.4.8.2.10	*Data Latency*	15 min	TBD

3.4.8.3 CLEAR SKY MASKS: MESOSCALE

3.4.8.3.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.8.3.2	*User & Priority (LO-#)*	OAR/NSSL-3	OAR/NSSL-3
3.4.8.3.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.8.3.4	*Vertical Resolution*	TBD	TBD
3.4.8.3.5	*Horizontal Resolution*	2 km	0.5 km
3.4.8.3.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.8.3.7	*Measurement Range*	0 – 1 Binary	0 – 1 Binary
3.4.8.3.8	*Measurement Accuracy*	10%	5%
3.4.8.3.9	*Refresh Rate*	5 min	1 min
3.4.8.3.10	*Data Latency*	5 min	5 min

3.4.8.4 RADIANCES: CONUS

3.4.8.4.1 Definition

Total energy radiated by an object of unit area per solid angle of measurement. Standard measurement unit W/m^2.

The observed radiance of the top of the atmosphere in the Thermal Infra Red (TIR), microwave (MW) and visible (VIS) bands. Radiance obtained along a spectral band on a specific target is converted into brightness temperature using tables derived from Planck's formula.

Attribute		Threshold	Objective
3.4.8.4.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-1 NESDIS/ORA-3 OAR/FSL-3	NWS/NCEP/EMC-1 NESDIS/ORA-3 OAR/FSL-3
3.4.8.4.3	*Geographic Coverage*	62° LZA	CONUS
3.4.8.4.4	*Vertical Resolution*	TBD	TBD
3.4.8.4.5	*Horizontal Resolution*	10 km	1 km
3.4.8.4.6	*Mapping Accuracy*	5 km	0.5 km
3.4.8.4.7	*Measurement Range*	180K-320K (VIS & IR only)	180K-330K (VIS, IR & MW)
3.4.8.4.8	*Measurement Accuracy*	TBD	TBD
3.4.8.4.9	*Refresh Rate*	60 min	10 min
3.4.8.4.10	*Data Latency*	10 min	1 min

3.4.8.5 RADIANCES: HEMISPHERIC

3.4.8.5.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.8.5.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-1 NESDIS/ORA-3 Climate-1	NWS/NCEP/EMC-1 NESDIS/ORA-3 Climate-1
3.4.8.5.3	*Geographic Coverage*	62° LZA	Hemispheric
3.4.8.5.4	*Vertical Resolution*	TBD	TBD
3.4.8.5.5	*Horizontal Resolution*	10 km	4 km
3.4.8.5.6	*Mapping Accuracy*	5 km	1 km
3.4.8.5.7	*Measurement Range*	180K-320K (VIS & IR only)	180K-330K (VIS, IR & MW)
3.4.8.5.8	*Measurement Accuracy*	0.1 K	TBD
3.4.8.5.9	*Refresh Rate*	60 min	15 min
3.4.8.5.10	*Data Latency*	60 min	15 min
3.4.8.5.11	*Long-term Stability*	TBD	0.04 K

3.4.8.6 RADIANCES: MESOSCALE

3.4.8.6.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.8.6.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-1	NWS/NCEP/EMC-1
3.4.8.6.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.8.6.4	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb + : 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb + : 2 km
3.4.8.6.5	*Horizontal Resolution*	4 km	0.5 km
3.4.8.6.6	*Mapping Accuracy*	2 km	0.2 km
3.4.8.6.7	*Measurement Range*	180K-330K (VIS & IR only)	180K-330K (VIS, IR & MW)
3.4.8.6.8	*Measurement Accuracy*	TBD	TBD
3.4.8.6.9	*Refresh Rate*	60 min	10 min
3.4.8.6.10	*Data Latency*	30 min	5 min

3.4.9 Performance Characteristics: Atmosphere / Radiation

3.4.9.1 ABSORBED SHORTWAVE RADIATION: SURFACE / MESOSCALE

3.4.9.1.1 Definition

Incoming shortwave radiation is radiation received from the Sun at wavelengths shorter than 4 μm. Sometimes called the solar radiation. Usually radiation in the visible and near-infrared wavelengths. Incoming solar radiation that strikes the earth's surface and is absorbed by the earth's surface [*WMO, 1966*].

Attribute		Threshold	Objective
3.4.9.1.2	*User & Priority (LO-#)*	NOS/ORR-1	NOS/ORR-1
3.4.9.1.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.9.1.4	*Horizontal Resolution*	5 km	300 m
3.4.9.1.5	*Mapping Accuracy*	< 0.5 km	< 30 m
3.4.9.1.6	*Measurement Range*	0 – 700 W/m^2	0 – 700 W/m^2
3.4.9.1.7	*Measurement Accuracy*	7 W/m^2	5 W/m^2
3.4.9.1.8	*Refresh Rate*	60 min	15 min
3.4.9.1.9	*Data Latency*	60 min	5 min

3.4.9.2 DOWNWARD LONGWAVE RADIATION: SURFACE / CONUS

3.4.9.2.1 Definition

Longwave radiation is radiation with wavelengths longer than 4 μm. Also referred to as infrared radiation or terrestrial radiation.

The downward component of longwave radiation across a given surface, usually taken as the earth's surface. It is also known as counter radiation Counter radiation originates in emission by clouds and greenhouse gases at different heights and temperatures, and is modified by subsequent absorption before reaching the surface [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.4.9.2.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-2	NOS/ORR-1
3.4.9.2.3	*Geographic Coverage*	CONUS	Hemispheric
3.4.9.2.4	*Horizontal Resolution*	25 km	2 km
3.4.9.2.5	*Mapping Accuracy*	5 km	1 km
3.4.9.2.6	*Measurement Range*	0 – 700 W/m^2	0 – 700 W/m^2
3.4.9.2.7	*Measurement Accuracy*	TBD	5 W/m^2
3.4.9.2.8	*Refresh Rate*	60 min	15 min
3.4.9.2.9	*Data Latency*	60 min	15 min

3.4.9.3 DOWNWARD LONGWAVE RADIATION: SURFACE / HEMISPHERIC

3.4.9.3.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.9.3.2	*User & Priority (LO-#)*	Climate-1 Hydrology Program - UA	Climate-1 Hydrology Program - UA
3.4.9.3.3	*Geographic Coverage*	Hemispheric	Hemispheric
3.4.9.3.4	*Horizontal Resolution*	100 km	10 km
3.4.9.3.5	*Mapping Accuracy*	TBD	TBD
3.4.9.3.6	*Measurement Range*	TBD	TBD
3.4.9.3.7	*Measurement Accuracy*	TBD	1 W/m^2
3.4.9.3.8	*Refresh Rate*	60 min	15 min
3.4.9.3.9	*Data Latency*	TBD	TBD
3.4.9.3.10	*Long-term Stability*	TBD	0.2 W/m^2

3.4.9.4 DOWNWARD SOLAR INSOLATION: SURFACE / CONUS

3.4.9.4.1 Definition

"Solar" refers to electromagnetic radiation in the spectral range of approximately 0.30 to 3.0 μm. Solar radiation is also often referred to as shortwave with the shortest wavelengths of solar known as UV, the middle wavelengths are in the visible part of the spectrum, and the wavelengths longer than visible are known as the near or solar infrared (IR).

The total solar radiation received at the earth's surface. Also know as the total downward solar irradiance. It is the total amount of solar irradiance on an upward-facing horizontal surface and is the sum of the vertical component of the direct solar irradiance and the diffuse sky irradiance. This is the fundamental quantity from which the world's weather/climate system obtains its energy. [*Measured Radiation Quantities*]

Attribute		Threshold	Objective
3.4.9.4.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-2	NWS/NCEP/EMC-2
3.4.9.4.3	*Geographic Coverage*	CONUS	Hemispheric
3.4.9.4.4	*Horizontal Resolution*	25 km	2 km
3.4.9.4.5	*Mapping Accuracy*	2 km	1 km
3.4.9.4.6	*Measurement Range*	0 - 1500 W/m^2	0 - 1500 W/m^2
3.4.9.4.7	*Measurement Accuracy*	± 60 W/m^2 at high end of range (1500 W/m2) ± 40 W/m^2 at typical value/mid-point (350 W/m^2)	± 60 W/m^2 at high end of range (1500 W/m2) ± 40 W/m^2 at typical value/mid-point (350 W/m^2)
3.4.9.4.8	*Refresh Rate*	60 min	15 min
3.4.9.4.9	*Data Latency*	60 min	15 min

3.4.9.5 DOWNWARD SOLAR INSOLATION: SURFACE / HEMISPHERIC

3.4.9.5.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.9.5.2	*User & Priority (LO-#)*	Climate-1 NOS/ORR-1 Hydrology Program - UA	Climate-1 NOS/ORR-1 Hydrology Program - UA
3.4.9.5.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.9.5.4	*Horizontal Resolution*	50 km	10 km
3.4.9.5.5	*Mapping Accuracy*	TBD	TBD
3.4.9.5.6	*Measurement Range*	TBD	TBD
3.4.9.5.7	*Measurement Accuracy*	TBD	1 W/m^2
3.4.9.5.8	*Refresh Rate*	60 min	15 min
3.4.9.5.9	*Data Latency*	60 min	5 min
3.4.9.5.10	*Long-term Stability*	TBD	0.3 W/m^2

3.4.9.6 DOWNWARD SOLAR INSOLATION: SURFACE / MESOSCALE

3.4.9.6.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.9.6.2	*User & Priority (LO-#)*	NOS/ORR-1	NOS/ORR-1
3.4.9.6.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.9.6.4	*Horizontal Resolution*	5 km	300 m
3.4.9.6.5	*Mapping Accuracy*	TBD	TBD
3.4.9.6.6	*Measurement Range*	TBD	TBD
3.4.9.6.7	*Measurement Accuracy*	TBD	TBD
3.4.9.6.8	*Refresh Rate*	60 min	15 min
3.4.9.6.9	*Data Latency*	60 min	5 min

3.4.9.7 REFLECTED SOLAR INSOLATION: TOP OF THE ATMOSPHERE (TOA) / CONUS

3.4.9.7.1 Definition

"Solar" refers to electromagnetic radiation in the spectral range of approximately 0.30 to 3.0 μm. Solar radiation is also often referred to as shortwave with the shortest wavelengths of solar known as UV, the middle wavelengths are in the visible part of the spectrum, and the wavelengths longer than visible are known as the near or solar infrared (IR).

Reflected Solar Insolation (TOA) is the quantity of solar irradiance incident upon a downward-facing surface, i.e., the top of the atmosphere. The source of the quantity is the downward solar irradiance that is reflected off the earth's surface. [*Measured Radiation Quantities*]

Attribute		Threshold	Objective
3.4.9.7.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-2	NWS/NCEP/EMC-2
3.4.9.7.3	*Geographic Coverage*	CONUS	Hemispheric
3.4.9.7.4	*Horizontal Resolution*	25 km	2 km
3.4.9.7.5	*Mapping Accuracy*	2 km	1 km
3.4.9.7.6	*Measurement Range*	0 - 1500 W/m^2	0 - 1500 W/m^2
3.4.9.7.7	*Measurement Accuracy*	± 60 W/m^2 at high end of range (1500 W/m2) ± 40 W/m^2 at typical value/mid-point (350 W/m^2)	± 60 W/m^2 at high end of range (1500 W/m2) ± 40 W/m^2 at typical value/mid-point (350 W/m^2)
3.4.9.7.8	*Refresh Rate*	60 min	15 min
3.4.9.7.9	*Data Latency*	60 min	15 min

3.4.9.8 REFLECTED SOLAR INSOLATION: TOP OF THE ATMOSPHERE (TOA) / HEMISPHERIC

3.4.9.8.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.9.8.2	*User & Priority (LO-#)*	Climate-1 Europeans - UA	Climate-1 Europeans - UA
3.4.9.8.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.9.8.4	*Vertical Resolution*	TBD	TBD
3.4.9.8.5	*Horizontal Resolution*	100 km	25 km
3.4.9.8.6	*Mapping Accuracy*	TBD	TBD
3.4.9.8.7	*Measurement Range*	TBD	TBD
3.4.9.8.8	*Measurement Accuracy*	TBD	1 W/m^2
3.4.9.8.9	*Refresh Rate*	60 min	15 min
3.4.9.8.10	*Data Latency*	TBD	TBD
3.4.9.8.11	*Long-term Stability*	TBD	0.3 W/m^2

3.4.9.9 UPWARD LONGWAVE RADIATION: SURFACE / CONUS

3.4.9.9.1 Definition

The outgoing longwave radiation (OLR) at the earth's surface refers specifically to the radiation emitted by the earth and its atmosphere (the terrestrial radiation) [*WMO, 1966*].

Attribute		Threshold	Objective
3.4.9.9.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-2	NWS/NCEP/EMC-2
3.4.9.9.3	*Geographic Coverage*	CONUS	Hemispheric
3.4.9.9.4	*Horizontal Resolution*	25 km	2 km
3.4.9.9.5	*Mapping Accuracy*	5 km	1 km
3.4.9.9.6	*Measurement Range*	0 - 700 W/m^2	0 - 700 W/m^2
3.4.9.9.7	*Measurement Accuracy*	TBD	5 W/m^2
3.4.9.9.8	*Refresh Rate*	60 min	15 min
3.4.9.9.9	*Data Latency*	60 min	15 min

3.4.9.10 UPWARD LONGWAVE RADIATION: SURFACE / HEMISPHERIC

3.4.9.10.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.9.10.2	*User & Priority (LO-#)*	Climate-1 Hydrology Program - UA	Climate-1 Hydrology Program - UA
3.4.9.10.3	*Geographic Coverage*	62° LZA	Hemispheric
3.4.9.10.4	*Vertical Resolution*	TBD	TBD
3.4.9.10.5	*Horizontal Resolution*	100 km	10 km
3.4.9.10.6	*Mapping Accuracy*	TBD	TBD
3.4.9.10.7	*Measurement Range*	TBD	TBD
3.4.9.10.8	*Measurement Accuracy*	TBD	1 W/m^2
3.4.9.10.9	*Refresh Rate*	60 min	15 min
3.4.9.10.10	*Data Latency*	TBD	TBD
3.4.9.10.11	*Long-term Stability*	TBD	0.2 W/m^2

3.4.9.11 UPWARD LONGWAVE RADIATION: TOA / CONUS

3.4.9.11.1 Definition

The outgoing longwave radiation (OLR) at the top of the atmosphere refers specifically to the radiation emitted by the earth and its atmosphere (the terrestrial radiation). Satellite measurements of the OLR from terrestrial surfaces and clouds show that OLR is low over cold land and high clouds and high over hot land surfaces. Climate variations, such as El Niño Southern Oscillation (ENSO) can be measured from OLR anomalies from longer-term variations [*WMO, 1966*].

Attribute		Threshold	Objective
3.4.9.11.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-2	NWS/NCEP/EMC-2
3.4.9.11.3	*Geographic Coverage*	CONUS	CONUS
3.4.9.11.4	*Horizontal Resolution*	25 km	2 km
3.4.9.11.5	*Mapping Accuracy*	5 km	1 km
3.4.9.11.6	*Measurement Range*	0 – 700 W/m^2	0 – 700 W/m^2
3.4.9.11.7	*Measurement Accuracy*	TBD	5 W/m^2
3.4.9.11.8	*Refresh Rate*	60 min	15 min
3.4.9.11.9	*Data Latency*	60 min	15 min

3.4.9.12 UPWARD LONGWAVE RADIATION: TOA / HEMISPHERIC

3.4.9.12.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.9.12.2	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/EMC-2 Europeans - UA	Climate-1 NWS/NCEP/EMC-2 Europeans - UA
3.4.9.12.3	*Geographic Coverage*	Hemispheric	Hemispheric
3.4.9.12.4	*Horizontal Resolution*	25 km	2 km
3.4.9.12.5	*Mapping Accuracy*	5 km	1 km
3.4.9.12.6	*Measurement Range*	0 – 700 W/m^2	0 – 700 W/m^2
3.4.9.12.7	*Measurement Accuracy*	20 W/m^2	1 W/m^2
3.4.9.12.8	*Refresh Rate*	60 min	15 min
3.4.9.12.9	*Data Latency*	60 min	15 min
3.4.9.12.10	*Long-term Stability*	TBD	0.2 W/m^2

3.4.10 Performance Characteristics: Atmosphere / Trace Gases

3.4.10.1 CO CONCENTRATION

3.4.10.1.1 Definition

Concentration of Carbon Monoxide (CO). CO is a toxic, odorless, colorless gas produced during fossil fuel or biomass burning. It is one of the longest-lived, naturally occurring atmospheric carbon compounds. The recent change in tropospheric CO content may portend a change in the balance between oxidants and reductants in the atmosphere. [Journal of Geophysical Research, v95, 16443-16450, 1990] [Scientific American, v261, 82-88, 1989] [*Atmospheric and Air Chemistry Glossary*]

Attribute		Threshold	Objective
3.4.10.1.2	*User & Priority (LO-#)*	NESDIS/ORA-3	NESDIS/ORA-3
3.4.10.1.3	*Geographic Coverage*	TBD	Hemispheric
3.4.10.1.4	*Vertical Resolution*	TBD	Total
3.4.10.1.5	*Horizontal Resolution*	TBD	50 km
3.4.10.1.6	*Mapping Accuracy*	TBD	TBD
3.4.10.1.7	*Measurement Range*	TBD	TBD
3.4.10.1.8	*Measurement Accuracy*	TBD	±5%
3.4.10.1.9	*Refresh Rate*	TBD	60 min
3.4.10.1.10	*Data Latency*	TBD	TBD

3.4.10.2 OZONE LAYERS: HEMISPHERIC

3.4.10.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.10.2.2	*User & Priority (LO-#)*	NESDIS/ORA-3 Europeans - UA	NESDIS/ORA-3 Europeans - UA
3.4.10.2.3	*Geographic Coverage*	62° LZA	Hemispheric
3.4.10.2.4	*Vertical Resolution*	0 - 10 km: 3 km 10 - 25 km: TBD	TBD
3.4.10.2.5	*Horizontal Resolution*	10 km	4 km
3.4.10.2.6	*Mapping Accuracy*	TBD	TBD
3.4.10.2.7	*Measurement Range*	TBD	TBD
3.4.10.2.8	*Measurement Accuracy*	TBD	TBD
3.4.10.2.9	*Refresh Rate*	60 min	TBD
3.4.10.2.10	*Data Latency*	TBD	TBD

3.4.10.3 OZONE TOTAL: CONUS

3.4.10.3.1 Definition

Measurement of ozone concentration within a specified volume. The ozone layer in the stratosphere absorbs UV radiation and creates a warm layer of air high in the stratosphere. Ozone that is present in the troposphere is mostly a result of anthropogenic pollution and therefore higher concentrations are found in urban areas. Ozone is involved in the photochemical production of many of the constituents of pollution environments (see nitrogen oxides and hydroxyl definitions). [Chemical and Engineering News, v72, 6-7, 1994] [Aviation Week and Space Technology, v140, 20-21, 1994] [*Atmospheric and Air Chemistry Glossary*]

A Dobson Unit is a measurement unit for determining the total amount of ozone present in a vertical column of air above the surface of the earth. An air layer at atmospheric pressure of 1013 hPa and temperature of 298 K which measures 1 mm in thickness and is equivalent to 100 dobson units.

Attribute		Threshold	Objective
3.4.10.3.2	*User & Priority (LO-#)*	OAR/FSL-3	OAR/FSL-3
3.4.10.3.3	*Geographic Coverage*	CONUS	Hemispheric
3.4.10.3.4	*Vertical Resolution*	TBD	TBD
3.4.10.3.5	*Horizontal Resolution*	10 km	2 km
3.4.10.3.6	*Mapping Accuracy*	5 km	0.5 km
3.4.10.3.7	*Measurement Range*	50 - 650 DU	50 - 650 DU
3.4.10.3.8	*Measurement Accuracy*	TBD	2%
3.4.10.3.9	*Refresh Rate*	60 min	30 min
3.4.10.3.10	*Data Latency*	5 min	3 min

3.4.10.4 OZONE TOTAL: HEMISPHERIC

3.4.10.4.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.10.4.2	*User & Priority (LO-#)*	NESDIS/OSDPD-2 NESDIS/ORA-3 Europeans - UA	NESDIS/OSDPD-2 NESDIS/ORA-3 Europeans - UA
3.4.10.4.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.10.4.4	*Vertical Resolution*	TBD	TBD
3.4.10.4.5	*Horizontal Resolution*	10 km	2 km
3.4.10.4.6	*Mapping Accuracy*	5 km	0.5 km
3.4.10.4.7	*Measurement Range*	100 - 650 DU	100 - 650 DU
3.4.10.4.8	*Measurement Accuracy*	TBD	TBD
3.4.10.4.9	*Refresh Rate*	60 min	30 min
3.4.10.4.10	*Data Latency*	5 min	3 min

3.4.10.5 SO_2 DETECTION

3.4.10.5.1 Definition

Detection of Sulfur Dioxide (SO_2). SO_2 is a non-inflammable colorless gas. SO_2 is usually oxidized by ozone and hydrogen peroxide to form sulfur trioxide, a secondary pollutant that is extremely soluble in water. Droplets of sulfuric acid (acid rain) are formed when sulfur oxides are present in the atmosphere. The production of SO_2 originating from coal-fired power plants and other fossil fuel combustion is largely responsible for the damage caused by acid rain. Volcanic eruptions also provide a source of sulfur dioxide in the atmosphere but are insignificant when compared to anthropogenic sources. [Science, v265, 497-9, 1994.] [Nature, v366, 327-9, 1993] [*Atmospheric and Air Chemistry Glossary*]

Attribute		Threshold	Objective
3.4.10.5.2	*User & Priority (LO-#)*	NESDIS/ORA-3	NESDIS/ORA-3
3.4.10.5.3	*Geographic Coverage*	Full Disk	Global
3.4.10.5.4	*Vertical Resolution*	Total Column	Total Column
3.4.10.5.5	*Horizontal Resolution*	5 km	1 km
3.4.10.5.6	*Mapping Accuracy*	1 km	0.5 km
3.4.10.5.7	*Measurement Range*	Binary Yes/No Above TBD Dobson Units (DU)	0 - 700 DU
3.4.10.5.8	*Measurement Accuracy*	TBD	1 %
3.4.10.5.9	*Refresh Rate*	60 min	15 min
3.4.10.5.10	*Data Latency*	15 min	5 min

3.4.11 Performance Characteristics: Atmosphere / Winds

3.4.11.1 DERIVED MOTION WINDS: CONUS

3.4.11.1.1 Definition

Produced by tracking features in satellite water vapor and shortwave IR window channels data. These are designated as ‘water vapor’ and ‘cloud drift’ winds. The latter are also called ‘shortwave’ and 'infrared' winds. [*GOES Products and Services Catalog*].

Attribute		Threshold	Objective
3.4.11.1.2	*User & Priority (LO-#)*	NWS/NCEP/TPC-1 NWS/NCEP/AWC-1 NWS/WFO-1 OAR/AOML/HRD-1 NESDIS/ORA-3 DoD/USA-1	NWS/NCEP/TPC-1 NWS/NCEP/AWC-1 NWS/WFO-1 OAR/AOML/HRD-1 NESDIS/ORA-3 DoD/USA-1
3.4.11.1.3	*Geographic Coverage*	CONUS	CONUS
3.4.11.1.4	*Vertical Resolution*	4 levels: Low, Mid, Mid-High, High	TBD
3.4.11.1.5	*Horizontal Resolution*	2 km	0.2 km
3.4.11.1.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.11.1.7	*Measurement Range*	0 - 300 kts (0 – 155 m/s)	0 - 300 kts (0 – 155 m/s)
3.4.11.1.8	*Measurement Accuracy*	2.5 m/s	0.5 m/s
3.4.11.1.9	*Refresh Rate*	5 min	5 min
3.4.11.1.10	*Data Latency*	3 min	1 min

3.4.11.2 DERIVED MOTION WINDS: HEMISPHERIC

3.4.11.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.11.2.2	*User & Priority (LO-#)*	NWS/NCEP/TPC-1 NWS/NCEP/AWC-1 NWS/WFO-1 OAR/AOML/HRD-1 Climate-2 NESDIS/ORA-3 Hydrology Program - UA DoD/USAF-1 DoD/USN-USMC-1 Europeans - UA	NWS/NCEP/TPC-1 NWS/NCEP/AWC-1 NWS/WFO-1 OAR/AOML/HRD-1 Climate-2 NESDIS/ORA-3 Hydrology Program - UA DoD/USAF-1 DoD/USN-USMC-1 Europeans - UA
3.4.11.2.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.11.2.4	*Vertical Resolution*	4 levels: Low, Mid, Mid-High, High	TBD
3.4.11.2.5	*Horizontal Resolution*	2 km	0.2 km
3.4.11.2.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.11.2.7	*Measurement Range*	0 - 300 kts (0 – 155 m/s)	0 - 300 kts (0 – 155 m/s)
3.4.11.2.8	*Measurement Accuracy*	7 m/s	0.5 m/s
3.4.11.2.9	*Refresh Rate*	5 min	5 min
3.4.11.2.10	*Data Latency*	3 min	1 min
3.4.11.2.11	*Long-term Stability*	TBD	TBD

3.4.11.3 DERIVED MOTION WINDS: MESOSCALE

3.4.11.3.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.11.3.2	*User & Priority (LO-#)*	NWS/NCEP/TPC-1 NWS/NCEP/AWC-1 NWS/WFO-1 OAR/AOML/HRD-1 OAR/NSSL-1 NESDIS/ORA-3 DoD/USA-1	NWS/NCEP/TPC-1 NWS/NCEP/AWC-1 NWS/WFO-1 OAR/AOML/HRD-1 OAR/NSSL-1 NESDIS/ORA-3 DoD/USA-1
3.4.11.3.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.11.3.4	*Vertical Resolution*	4 levels: Low, Mid, Mid-High, High	TBD
3.4.11.3.5	*Horizontal Resolution*	2 km	0.2 km
3.4.11.3.6	*Mapping Accuracy*	1.0 km	0.2 km
3.4.11.3.7	*Measurement Range*	0 - 300 kts (0 – 155 m/s)	0 - 300 kts (0 – 155 m/s)
3.4.11.3.8	*Measurement Accuracy*	2.5 m/s	0.5 m/s
3.4.11.3.9	*Refresh Rate*	5 min	5 min
3.4.11.3.10	*Data Latency*	3 min	1 min

3.4.11.4 MICROBURST WINDSPEED POTENTIAL

3.4.11.4.1 Definition

A microburst is an intense downdraft (downburst) less than 4 km wide (about 2.5 miles) that may occur beneath a thunderstorm. The intense localized downdraft results in an outward burst of damaging winds on or near the ground.

Attribute		Threshold	Objective
3.4.11.4.2	*User & Priority (LO-#)*	NWS/NCEP/AWC-1	NWS/NCEP/AWC-1
3.4.11.4.3	*Geographic Coverage*	CONUS	CONUS
3.4.11.4.4	*Vertical Resolution*	TBD	TBD
3.4.11.4.5	*Horizontal Resolution*	10 km	0.2 km
3.4.11.4.6	*Mapping Accuracy*	5 km	0.2 km
3.4.11.4.7	*Measurement Range*	TBD	TBD
3.4.11.4.8	*Measurement Accuracy*	TBD	TBD
3.4.11.4.9	*Refresh Rate*	60 min	1 min
3.4.11.4.10	*Data Latency*	3 min	1 min

3.4.12 Performance Characteristics: Land

3.4.12.1 FIRE / HOT SPOT IMAGERY: CONUS

3.4.12.1.1 Definition

Active burning, due to its high temperature, emits a strong radiative signature in the visible and infrared region of the electromagnetic spectrum. A satellite pixel that exhibits high temperatures is known as a hotspot and these pixels are indicated by red dots on a hotspot map showing the approximate positions of the fire.

Attribute		Threshold	Objective
3.4.12.1.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1 NESDIS/ORA-3	NESDIS/OSDPD-1 NESDIS/ORA-3
3.4.12.1.3	*Geographic Coverage*	CONUS	CONUS
3.4.12.1.4	*Horizontal Resolution*	2 km	0.25 km
3.4.12.1.5	*Mapping Accuracy*	1.0 km	0.20 km
3.4.12.1.6	*Measurement Range*	275 – 400 K	275 – 700 K
3.4.12.1.7	*Measurement Accuracy*	2.0 K	0.1 K
3.4.12.1.8	*Refresh Rate*	5 min	1 min
3.4.12.1.9	*Data Latency*	5 min	1 min
3.4.12.1.10	*Long-term Stability*	TBD	TBD

3.4.12.2 FIRE / HOT SPOT IMAGERY: HEMISPHERIC

3.4.12.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.12.2.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1 NESDIS/ORA-3	NESDIS/OSDPD-1 NESDIS/ORA-3
3.4.12.2.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.12.2.4	*Horizontal Resolution*	2 km	0.25 km
3.4.12.2.5	*Mapping Accuracy*	1.0 km	0.20 km
3.4.12.2.6	*Measurement Range*	275 - 400 K	275 - 700 K
3.4.12.2.7	*Measurement Accuracy*	2.0 K	0.1 K
3.4.12.2.8	*Refresh Rate*	15 min	5 min
3.4.12.2.9	*Data Latency*	5 min	1 min
3.4.12.2.10	*Long-term Stability*	TBD	TBD

3.4.12.3 FLOOD/STANDING WATER: HEMISPHERIC

3.4.12.3.1 Definition

Accumulation of water over areas that are not normally submerged. A flooded area is an area covered by water when stream flow exceeds the carrying capacity of a channel or as a consequence of damming a river downstream [*UNESCO/WMO*].

Attribute		Threshold	Objective
3.4.12.3.2	*User & Priority (LO-#)*	Hydrology Program - UA DoD/USA-1 DoD/USN&USMC-2	Hydrology Program - UA DoD/USA-1 DoD/USN&USMC-2
3.4.12.3.3	*Geographic Coverage*	Full Disk	Full Disk
3.4.12.3.4	*Sensing Depth / Vertical Resolution*	5 cm	2 cm
3.4.12.3.5	*Horizontal Resolution*	10 km	0.1 km
3.4.12.3.6	*Mapping Accuracy*	1 km	0.5 km
3.4.12.3.7	*Measurement Range*	0% - 100%	TBD
3.4.12.3.8	*Refresh Rate*	60 min	60 min
3.4.12.3.9	*Data Latency*	24 hr	3 hr
3.4.12.3.10	*Long-term Stability*	TBD	TBD

3.4.12.4 FLOOD/STANDING WATER: MESOSCALE

3.4.12.4.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.12.4.2	*User & Priority (LO-#)*	DoD/USN&USMC-2	DoD/USN&USMC-2
3.4.12.4.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.12.4.4	*Sensing Depth / Vertical Resolution*	5 cm	2 cm
3.4.12.4.5	*Horizontal Resolution*	10 km	1 km
3.4.12.4.6	*Mapping Accuracy*	1 km	0.5 km
3.4.12.4.7	*Measurement Range*	0% - 100%	0% - 100%
3.4.12.4.8	*Refresh Rate*	60 min	TBD
3.4.12.4.9	*Data Latency*	6 hr	TBD
3.4.12.4.10	*Long-term Stability*	TBD	TBD

3.4.12.5 ICE COVER/LANDLOCKED: HEMISPHERIC

3.4.12.5.1 Definition

Extent of ice (i.e. glaciers, permafrost, and ice sheets) over land, frozen inland lakes, and rivers [*Environmental Vulnerability Index*].

Attribute		Threshold	Objective
3.4.12.5.2	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.4.12.5.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.12.5.4	*Horizontal Resolution*	TBD	10 km
3.4.12.5.5	*Mapping Accuracy*	TBD	5 km
3.4.12.5.6	*Measurement Range*	TBD	TBD
3.4.12.5.7	*Measurement Accuracy*	TBD	TBD
3.4.12.5.8	*Refresh Rate*	TBD	180 min
3.4.12.5.9	*Data Latency*	TBD	60 min
3.4.12.5.10	*Long-term Stability*	TBD	TBD

3.4.12.6 LAND SURFACE (SKIN) TEMPERATURE: CONUS

3.4.12.6.1 Definition

Land surface temperature is defined as the skin temperature of the uppermost layer of the land surface. It is the surface temperature at which the outgoing radiative flux at the surface balances the incoming radiative flux. It has two major applications: 1) characterization of backgrounds for electro-optical systems; and 2) use in infrared cloud/no cloud decision for processed cloud data.

Attribute		Threshold	Objective
3.4.12.6.2	*User & Priority (LO-#)*	NESDIS/ORA-2 NESDIS/OSDPD-2 NWS/NCEP/EMC-2 NWS/WFO-3 DoD/USA-1	NESDIS/ORA-2 NESDIS/OSDPD-2 NWS/NCEP/EMC-2 NWS/WFO-3 DoD/USA-1
3.4.12.6.3	*Geographic Coverage*	CONUS	CONUS
3.4.12.6.4	*Horizontal Resolution*	2 km	2 km
3.4.12.6.5	*Mapping Accuracy*	1 km	0.5 km
3.4.12.6.6	*Measurement Range*	233 – 333 K	213 – 343 K
3.4.12.6.7	*Measurement Accuracy*	1.0 K	0.3 K
3.4.12.6.8	*Refresh Rate*	60 min	15 min
3.4.12.6.9	*Data Latency*	60min	15 min
3.4.12.6.10	*Long-term Stability*	TBD	TBD

3.4.12.7 LAND SURFACE (SKIN) TEMPERATURE: HEMISPHERIC

3.4.12.7.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.12.7.2	*User & Priority (LO-#)*	NESDIS/ORA-2 Climate-2 NWS/WFO-3 Hydrology Program - UA DoD/USN&USMC-1 DoD/USAF-1 Europeans - UA	NESDIS/ORA-2 Climate-2 NWS/WFO-3 Hydrology Program - UA DoD/USN&USMC-1 DoD/USAF-1 Europeans - UA
3.4.12.7.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.12.7.4	*Horizontal Resolution*	10 km	1 km
3.4.12.7.5	*Mapping Accuracy*	1 km	0.5 km
3.4.12.7.6	*Measurement Range*	233 – 333 K	183 – 343 K
3.4.12.7.7	*Measurement Accuracy*	1.0 K	0.3 K
3.4.12.7.8	*Refresh Rate*	60 min	15 min
3.4.12.7.9	*Data Latency*	3 min	1 min
3.4.12.7.10	*Long Term Stability*	TBD	TBD

3.4.12.8 LAND SURFACE (SKIN) TEMPERATURE: MESOSCALE

3.4.12.8.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.12.8.2	*User & Priority (LO-#)*	NESDIS/ORA-2 NWS/WFO-3 DoD/USA-1	NESDIS/ORA-2 NWS/WFO-3 DoD/USA-1
3.4.12.8.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.12.8.4	*Horizontal Resolution*	2 km	2 km
3.4.12.8.5	*Mapping Accuracy*	1 km	0.5 km
3.4.12.8.6	*Measurement Range*	233 – 333 K	223 – 343 K
3.4.12.8.7	*Measurement Accuracy*	1.0 K	0.3 K
3.4.12.8.8	*Refresh Rate*	60 min	15 min
3.4.12.8.9	*Data Latency*	3 min	1 min
3.4.12.8.10	*Long Term Stability*	TBD	TBD

3.4.12.9 SNOW COVER: CONUS

3.4.12.9.1 Definition

Horizontal extent of snow cover. Fraction of an area covered by snow. Unit of measurement is percent (%) [from Manual of the CEOS/WMO Database on User Requirements and *IN SITU* and Space Capabilities, Issue 1.4 - Aug 2002].

Attribute		Threshold	Objective
3.4.12.9.2	*User & Priority (LO-#)*	NESDIS/OSDPD-1 NWS/NOHRSC-1 NWS/NCEP/EMC-2 NESDIS/ORA-2 DoD/USA-1	NESDIS/OSDPD-1 NWS/NOHRSC-1 NWS/NCEP/EMC-2 NESDIS/ORA-2 DoD/USA-1
3.4.12.9.3	*Geographic Coverage*	CONUS	CONUS
3.4.12.9.4	*Horizontal Resolution*	2 km	0.5 km
3.4.12.9.5	*Mapping Accuracy*	1.0 km	0.2 km
3.4.12.9.6	*Measurement Range*	Binary yes/no detection	0.0 – 1.0 fractional cover
3.4.12.9.7	*Measurement Accuracy*	Binary yes/no detection	0.2 fraction
3.4.12.9.8	*Refresh Rate*	60 min	30 min
3.4.12.9.9	*Data Latency*	60 min	30 min
3.4.12.9.10	*Long Term Stability*	TBD	TBD

3.4.12.10 SNOW COVER: HEMISPHERIC

3.4.12.10.1 Definition

See requirement definition above.

Attribute	Threshold	Objective
3.4.12.10.2 *User & Priority (LO-#)*	NESDIS/OSDPD-1 NWS/NOHRSC-1 Climate-2 NESDIS/ORA-2 Hydrology Program - UA DoD/USA-1 DoD/USAF-1 DoD/USN&USMC-7 Europeans – UA	NESDIS/OSDPD-1 NWS/NOHRSC-1 Climate-2 NESDIS/ORA-2 Hydrology Program - UA DoD/USA-1 DoD/USAF-1 DoD/USN&USMC-7 Europeans – UA
3.4.12.10.3 *Geographic Coverage*	Full Disk	Hemispheric
3.4.12.10.4 *Horizontal Resolution*	2 km	0.5 km
3.4.12.10.5 *Mapping Accuracy*	1.0 km	0.2 km
3.4.12.10.6 *Measurement Range*	Binary yes/no detection	0.0 – 1.0 fractional cover
3.4.12.10.7 *Measurement Accuracy*	Binary yes/no detection	0.2 fraction
3.4.12.10.8 *Refresh Rate*	60 min	15 min
3.4.12.10.9 *Data Latency*	60 min	30 min
3.4.12.10.10 *Long Term Stability*	TBD	4%

3.4.12.11 SNOW COVER: MESOSCALE

3.4.12.11.1 Definition

See requirement definition above.

Attribute	Threshold	Objective
3.4.12.11.2 *User & Priority (LO-#)*	DoD/USA-1	DoD/USA-1
3.4.12.11.3 *Geographic Coverage*	Mesoscale	Mesoscale
3.4.12.11.4 *Horizontal Resolution*	2 km	1 km
3.4.12.11.5 *Mapping Accuracy*	1 km	1 km
3.4.12.11.6 *Measurement Range*	Binary yes/no detection	0 – 90 cm
3.4.12.11.7 *Measurement Accuracy*	Binary yes/no detection	± 2.5 cm
3.4.12.11.8 *Refresh Rate*	60 min	TBD
3.4.12.11.9 *Data Latency*	60 min	60 min
3.4.12.11.10 *Long Term Stability*	TBD	TBD

3.4.12.12 SNOW DEPTH: CONUS

3.4.12.12.1 Definition

Snow depth pertains to the measurement of the amount of water in a given snow pack. It is the vertical distance between the top of a snow layer and the horizontal ground beneath [*Glossary of Meteorology*].

Attribute	Threshold	Objective
3.4.12.12.2 *User & Priority (LO-#)*	NWS/NOHRSC-1 NWS/NCEP/EMC-2 NESDIS/ORA-2 NESDIS/OSDPD-3 DoD/USA-1	NWS/NOHRSC-1 NWS/NCEP/EMC-2 NESDIS/ORA-2 NESDIS/OSDPD-3 DoD/USA-1
3.4.12.12.3 *Geographic Coverage*	CONUS - Plains Only	Hemispheric
3.4.12.12.4 *Horizontal Resolution*	2 km	0.5 km
3.4.12.12.5 *Mapping Accuracy*	1 km	0.2 km
3.4.12.12.6 *Measurement Range*	TBD	0 - 20 m
3.4.12.12.7 *Measurement Accuracy*	TBD	0.5 cm
3.4.12.12.8 *Refresh Rate*	60 min	30 min
3.4.12.12.9 *Data Latency*	60 min	30 min
3.4.12.12.10 *Long Term Stability*	TBD	TBD

3.4.12.13 SNOW DEPTH: HEMISPHERIC

3.4.12.13.1 Definition

See requirement definition above.

Attribute	Threshold	Objective
3.4.12.13.2 *User & Priority (LO-#)*	NWS/NOHRSC-1 NESDIS/ORA-2 NESDIS/OSDPD-3 DoD/USA-1 DoD/USAF-1	NWS/NOHRSC-1 NESDIS/ORA-2 NESDIS/OSDPD-3 DoD/USA-1 DoD/USAF-1
3.4.12.13.3 *Geographic Coverage*	Full Disk - Plains Only	Hemispheric
3.4.12.13.4 *Horizontal Resolution*	2 km	0.5 km
3.4.12.13.5 *Mapping Accuracy*	1 km	0.2 km
3.4.12.13.6 *Measurement Range*	TBD	0 - 20 m
3.4.12.13.7 *Measurement Accuracy*	TBD	0.5 cm
3.4.12.13.8 *Refresh Rate*	60 min	30 min
3.4.12.13.9 *Data Latency*	60 min	30 min
3.4.12.13.10 *Long Term Stability*	TBD	TBD

3.4.12.14 SNOW DEPTH: MESOSCALE

3.4.12.14.1 Definition

See requirement definition above.

Attribute	Threshold	Objective
3.4.12.14.2 *User & Priority (LO-#)*	DoD/USA-1	DoD/USA-1
3.4.12.14.3 *Geographic Coverage*	Mesoscale – Plains Only	Mesoscale
3.4.12.14.4 *Horizontal Resolution*	2 km	1 km
3.4.12.14.5 *Mapping Accuracy*	1 km	1 km
3.4.12.14.6 *Measurement Range*	TBD	0 – 90 cm
3.4.12.14.7 *Measurement Accuracy*	TBD	± 2.5 cm
3.4.12.14.8 *Refresh Rate*	TBD	180 min
3.4.12.14.9 *Data Latency*	TBD	30 min
3.4.12.14.10 *Long Term Stability*	TBD	TBD

3.4.12.15 SURFACE ALBEDO: HEMISPHERIC

3.4.12.15.1 Definition

Measurement of the ratio of the amount of spectrum electromagnetic radiation reflected in the 0.4 - 4.0 μm band reflected by the earth to the amount incident upon it. This parameter is required during daytime only and under clear conditions only.

Attribute	Threshold	Objective
3.4.12.15.2 *User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.4.12.15.3 *Geographic Coverage*	Full Disk	Hemispheric
3.4.12.15.4 *Horizontal Resolution*	TBD	0.5 km
3.4.12.15.5 *Mapping Accuracy*	TBD	1 km
3.4.12.15.6 *Measurement Range*	0 – 1 Albedo Units	0 – 1 Albedo Units
3.4.12.15.7 *Measurement Accuracy*	TBD	± 1.25%
3.4.12.15.8 *Refresh Rate*	TBD	60 min
3.4.12.15.9 *Data Latency*	TBD	60 min
3.4.12.15.10 *Long Term Stability*	TBD	TBD

3.4.12.16 SURFACE EMISSIVITY

3.4.12.16.1 Definition

The ratio of the radiation emitted by a surface to the radiation emitted by a perfect blackbody radiator at the same temperature.

Attribute	Threshold	Objective
3.4.12.16.2 *User & Priority (LO-#)*	NESDIS/ORA-2 NWS/NCEP/EMC-2	NESDIS/ORA-2 NWS/NCEP/EMC-2
3.4.12.16.3 *Geographic Coverage*	CONUS	CONUS
3.4.12.16.4 *Horizontal Resolution*	10 km	2 km
3.4.12.16.5 *Mapping Accuracy*	5 km	0.5 km
3.4.12.16.6 *Measurement Range*	0.85 - 1.0	0.70 - 1.0
3.4.12.16.7 *Measurement Accuracy*	0.05	0.02
3.4.12.16.8 *Refresh Rate*	60 min	15 min
3.4.12.16.9 *Data Latency*	60 min	15 min
3.4.12.16.10 *Long Term Stability*	TBD	TBD

3.4.12.17 VEGETATION FRACTION: GREEN

3.4.12.17.1 Definition

Fraction of green vegetation, f_g. Vegetation is parameterized through the fractional area of active green vegetation occupying each model grid Cell (horizontal density). Fraction of green vegetation is unitless and ranges from 0 to 1.0.

Attribute	Threshold	Objective
3.4.12.17.2 *User & Priority (LO-#)*	NESDIS/ORA-2 NESDIS/OSDPD-2	NESDIS/ORA-2 NESDIS/OSDPD-2
3.4.12.17.3 *Geographic Coverage*	CONUS	CONUS
3.4.12.17.4 *Horizontal Resolution*	2 km	2 km
3.4.12.17.5 *Mapping Accuracy*	1 km	0.5 km
3.4.12.17.6 *Measurement Range*	0.0 - 1.0	0.0 - 1.0
3.4.12.17.7 *Measurement Accuracy*	0.05	0.02
3.4.12.17.8 *Refresh Rate*	60 min	30 min
3.4.12.17.9 *Data Latency*	60 min	30 min
3.4.12.17.10 *Long Term Stability*	TBD	TBD

3.4.12.18 VEGETATION INDEX: CONUS

3.4.12.18.1 Definition

Measure of biomass greenness in Normalized Difference Vegetation Index (NDVI) units. This parameter is required under clear conditions only.

Attribute	Threshold	Objective
3.4.12.18.2 *User & Priority (LO-#)*	NESDIS/ORA-2 NESDIS/OSDPD-2	NESDIS/ORA-2 NESDIS/OSDPD-2
3.4.12.18.3 *Geographic Coverage*	CONUS	CONUS
3.4.12.18.4 *Horizontal Resolution*	2 km	2 km
3.4.12.18.5 *Mapping Accuracy*	1 km	0.2 km
3.4.12.18.6 *Measurement Range*	0 - 1	0 - 1
3.4.12.18.7 *Measurement Accuracy*	0.04 NDVI Units	0.2 NDVI Units
3.4.12.18.8 *Refresh Rate*	60 min	30 min
3.4.12.18.9 *Data Latency*	60 min	30 min
3.4.12.18.10 *Long Term Stability*	TBD	TBD

3.4.13 Performance Characteristics: Ocean

3.4.13.1 CURRENTS: HEMISPHERIC

3.4.13.1.1 Definition

Ocean currents are defined as large-scale movements of the surface waters of the ocean driven by wind. The types of current that shall be measured are tidal, permanent, wave-induced, wind-induced, longshore and rip currents. Currents are a vector quantity with both speed and direction. This product is required under all weather and lighting conditions.

Attribute	Threshold	Objective
3.4.13.1.2 *User & Priority Category*	NWS/NCEP/OPC-1 DoD/USA-1	NWS/NCEP/OPC-1 DoD/USA-1
3.4.13.1.3 *Geographic Coverage*	Full Disk	Hemispheric
3.4.13.1.4 *Sensing Depth*	Surface	Surface
3.4.13.1.5 *Horizontal Resolution*	2 km	2 km
3.4.13.1.6 *Mapping Accuracy*	1.0 km	0.5 km
3.4.13.1.7 *Measurement Range*	0 to 5 m/s, 0 to 360 º	0 to 5 m/s, 0 to 360 º
3.4.13.1.8 *Measurement Accuracy*	1 km/hr	1 km/hr
3.4.13.1.9 *Refresh Rate*	6 hr	60 min
3.4.13.1.10 *Data Latency*	60 min	15 min

3.4.13.2 CURRENTS: MESOSCALE

3.4.13.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.13.2.2	*User & Priority Category*	NWS/NCEP/OPC-1	NWS/NCEP/OPC-1
3.4.13.2.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.13.2.4	*Sensing Depth*	Surface	Surface
3.4.13.2.5	*Horizontal Resolution*	2 km	2 km
3.4.13.2.6	*Mapping Accuracy*	1.0 km	0.5 km
3.4.13.2.7	*Measurement Range*	0 to 5 m/s, 0 to 360 º	0 to 5 m/s, 0 to 360 º
3.4.13.2.8	*Measurement Accuracy*	1 km/hr	1 km/hr
3.4.13.2.9	*Refresh Rate*	6 hr	60 min
3.4.13.2.10	*Data Latency*	60 min	15 min

3.4.13.3 CURRENTS: OFFSHORE / CONUS

3.4.13.3.1 Definition

See requirement definition above.

Offshore surface currents are defined as large-scale movements of the surface waters of the ocean farther than 100 km offshore.

This product is required under all weather and lighting conditions.

Attribute		Threshold	Objective
3.4.13.3.2	*User & Priority Category*	NOS/ALL-1 NWS/NCEP/OPC-1 NMFS/ALL-1	NOS/ALL-1 NWS/NCEP/OPC-1 NMFS/ALL-1
3.4.13.3.3	*Geographic Coverage*	CONUS & U.S. navigable waters thru EEZ	CONUS & U.S. navigable waters thru EEZ
3.4.13.3.4	*Sensing Depth*	Surface	Surface
3.4.13.3.5	*Horizontal Resolution*	2 km	2 km
3.4.13.3.6	*Mapping Accuracy*	1.0 km	0.5 km
3.4.13.3.7	*Measurement Range*	0 to 5 m/s, 0 to 360 º	0 to 5 m/s, 0 to 360 º
3.4.13.3.8	*Measurement Accuracy*	2 m/s	1 m/s
3.4.13.3.9	*Refresh Rate*	180 min	60 min
3.4.13.3.10	*Data Latency*	60 min	15 min

3.4.13.4 CURRENTS: OFFSHORE / HEMISPHERIC

3.4.13.4.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.13.4.2	*User & Priority Category*	DoD/USA-1	DoD/USA-1
3.4.13.4.3	*Geographic Coverage*	Full Disk	Hemispheric
3.4.13.4.4	*Horizontal Resolution*	TBD	5 km
3.4.13.4.5	*Mapping Accuracy*	TBD	5 km
3.4.13.4.6	*Measurement Range*	TBD	TBD
3.4.13.4.7	*Measurement Accuracy*	TBD	speed ±0.5 m/s
3.4.13.4.8	*Refresh Rate*	TBD	60 min
3.4.13.4.9	*Data Latency*	TBD	30 min

3.4.13.5 OCEAN COLOR: COASTAL (TURBIDITY/CHLOROPHYLL/REFLECTANCE)

3.4.13.5.1 Definition

Ocean color is defined as the spectrum of water-leaving radiances (Lw), i.e., the portion of visible - near infrared light that is reflected out of the water column, excluding light reflected at the surface. All geophysical quantities of interest, e.g., the concentration of the phytoplankton pigment chlorophyll a (chlorophyll-a), turbidity and reflectance are derived from these Lw values. Water-leaving radiances are measured in W m^{-2} μm^{-1} sr^{-1}. Chlorophyll a is measured in mg m^{-3}.

Coastal coverage refers to the areal extent consistent with the U.S. Exclusive Economic Zones (EEZ) that extend 370 km from shore. Coastal waters defined as far inland as the top of the watershed.

This product is required for clear daytime conditions only.

.Attribute		Threshold	Objective
3.4.13.5.2	*User & Priority Category*	NOS/ALL-1 NMFS/ALL-1	NOS/ALL-1 NMFS/ALL-1
3.4.13.5.3	*Geographic Coverage*	U.S. navigable waters thru EEZ	U.S. navigable waters thru EEZ
3.4.13.5.4	*Sensing Depth*	TBD	TBD
3.4.13.5.5	*Horizontal Resolution*	300 m	30 m
3.4.13.5.6	*Mapping Accuracy*	< 300 m	< 30 m
3.4.13.5.7	*Measurement Range*	WLR: 0.01 - 1 mW cm^{-2} μm^{-1} sr^{-1} CHL: 10^{-3}-10^{2} microgram/liter TURBID: 10^{-4} - 0.15 sr^{-1} REFL: 10^{-4} - 0.15 sr^{-1}	WLR: 0.01 - 1 mW cm^{-2} μm^{-1} sr^{-1} CHL: 10^{-3}-10^{2} microgram/liter TURBID: 10^{-4} - 0.15 sr^{-1} REFL: 10^{-4} - 0.15 sr^{-1}
3.4.13.5.8	*Measurement Accuracy*	<30% error	<30% error
3.4.13.5.9	*Refresh Rate*	180 min	60 min
3.4.13.5.10	*Data Latency*	60 min	30 min

3.4.13.6 OCEAN COLOR: CONUS/OFFSHORE (TURBIDITY/CHLOROPHYLL/REFLECTANCE)

3.4.13.6.1 Definition

See requirement definition above.

Offshore surface currents are defined as large-scale movements of the surface waters of the ocean farther than 100 km offshore.

Attribute		Threshold	Objective
3.4.13.6.2	*User & Priority Category*	NOS/ALL-1 NMFS/ALL-1	NOS/ALL-1 NMFS/ALL-1
3.4.13.6.3	*Geographic Coverage*	U.S. navigable waters thru EEZ	U.S. EEZ plus Gulf of Mexico and North Pacific
3.4.13.6.4	*Sensing Depth*	TBD	TBD
3.4.13.6.5	*Horizontal Resolution*	4 km	1 km
3.4.13.6.6	*Mapping Accuracy*	1 km	<1 km
3.4.13.6.7	*Measurement Range*	WLR: 0.01 - 1 mW cm^{-2} μm^{-1} sr^{-1} CHL: 10^{-3} - 10^{2} microgram/liter TURBID: 10^{-4} - 0.15 sr^{-1} REFL: 10^{-4} - 0.15 sr^{-1} (TBD)	WLR: 0.01 - 1 mW cm^{-2} μm^{-1} sr^{-1} CHL: 10^{-3} - 10^{2} microgram/liter TURBID: 10^{-4} - 0.15 sr^{-1} REFL: 10^{-4} - 0.15 sr^{-1} (TBD)
3.4.13.6.8	*Measurement Accuracy*	<30% error	<30% error
3.4.13.6.9	*Refresh Rate*	24 hrs	60 min
3.4.13.6.10	*Data Latency*	60 min	30 min

3.4.13.7 OCEAN COLOR: OFFSHORE (TURBIDITY/CHLOROPHYLL/REFLECTANCE)

3.4.13.7.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.13.7.2	*User & Priority Category*	Climate-2 NESDIS/ORA-UA	Climate-2 NESDIS/ORA-UA
3.4.13.7.3	*Geographic Coverage*	Hemispheric	Hemispheric
3.4.13.7.4	*Horizontal Resolution*	100 km	4 km
3.4.13.7.5	*Mapping Accuracy*	TBD	2 km
3.4.13.7.6	*Measurement Range*	TBD	WLR: 0.01 - 1 mW cm^{-2} μm^{-1} sr^{-1} CHL: 10^{-3} - 10^{2} microgram/liter TURBID: 10^{-4} - 0.15 sr^{-1} REFL: 10^{-4} - 0.15 sr^{-1} (TBD)
3.4.13.7.7	*Measurement Accuracy*	TBD	5%
3.4.13.7.8	*Refresh Rate*	60 min	15 min
3.4.13.7.9	*Data Latency*	TBD	TBD
3.4.13.7.10	*Long-term Stability*	TBD	1%

3.4.13.8 OCEAN TURBIDITY: HEMISPHERIC (TURBIDITY/VISIBILITY)

3.4.13.8.1 Definition

Turbidity is a measurement of the degree of scattering of light in water, related to the amount of suspended material in the water. Highly turbid ocean waters are those with a large number of scattering particulates in them. In both highly absorbing and highly scattering waters, visibility into the water is reduced. The highly scattering (turbid) water still reflects a lot of light while the highly absorbing water, such as a black water lake, is very dark. The scattering particles that cause the water to be turbid can be composed of many things, including sediments and phytoplankton. The turbidity is quantified as the percent reflected light emerging from the water column in a range of 0 to 8 percent [*Ocean Turbidity*].

Attribute		Threshold	Objective
3.4.13.8.2	*User & Priority Category*	NMFS/ALL-UA DoD/USA-1 DoD/USN-USMC-4	NMFS/ALL-UA DoD/USA-1 DoD/USN-USMC-4
3.4.13.8.3	*Geographic Coverage*	62° LZA	Hemispheric
3.4.13.8.4	*Sensing Depth*	0 to -10 m	0 to -100 m
3.4.13.8.5	*Horizontal Resolution*	5 km	300 m
3.4.13.8.6	*Mapping Accuracy*	2 km	300 m
3.4.13.8.7	*Measurement Range*	0 to 100 mg/m^3	TBD
3.4.13.8.8	*Measurement Accuracy*	<30% error	<30% error
3.4.13.8.9	*Refresh Rate*	180 min	60 min
3.4.13.8.10	*Data Latency*	60 min	60 min

3.4.13.9 OPTICAL PROPERTIES: COASTAL (PARTICULATE ABSORPTION, BACKSCATTER, FLUORESCENCE)

3.4.13.9.1 Definition

Ocean Color is defined as the spectrum of water-leaving radiances (Lw), i.e., the portion of visible - near infrared light that is reflected out of the water column, excluding light reflected at the surface. The inherent optical properties of absorption and scattering of surface waters (ocean optical properties), are derived from these Lw values. Water-leaving radiances are measured in W m^{-2} μm^{-1} sr^{-1}. Ocean optical properties, absorption and scattering, are estimated at each measured visible wavelength, and have units of inverse meters (m^{-1}). This product is required for clear daytime conditions only, for selected lakes, rivers, estuaries, bays, and other coastal regions that require higher resolution data.

Coastal coverage refers to the areal extent consistent with the U.S. Exclusive Economic Zones (EEZ) that extend 370 km from shore. Coastal waters defined as far inland as the top of the watershed.

Attribute		Threshold	Objective
3.4.13.9.2	*User & Priority Category*	NOS/ALL-2 NMFS/ALL-2 Europeans-UA	NOS/ALL-2 NMFS/ALL-2 Europeans-UA
3.4.13.9.3	*Geographic Coverage*	U.S. navigable waters thru EEZ	U.S. EEZ plus Gulf of Mexico and North Pacific
3.4.13.9.4	*Sensing Depth*	TBD	TBD
3.4.13.9.5	*Horizontal Resolution*	300 m	30 m
3.4.13.9.6	*Mapping Accuracy*	<300 m	<30 m
3.4.13.9.7	*Measurement Range*	Absorption: 0.01 - 10 m^{-1} Scattering: 0.01 - 50 m^{-1} Chlorophyll fluorescence: n/a	.005 - 20 m^{-1} 0.005 - 75 m^{-1} Detectable signal in waters with chlorophyll from 0.1 - 50 mg/m^3 at 1 km res
3.4.13.9.8	*Measurement Accuracy*	<30% error	<30% error
3.4.13.9.9	*Refresh Rate*	180 min	60 min
3.4.13.9.10	*Data Latency*	60 min	30 min

3.4.13.10 OPTICAL PROPERTIES: CONUS / OFFSHORE (PARTICULATE ABSORPTION, BACKSCATTER, FLUORESCENCE)

3.4.13.10.1 Definition

Ocean Color is defined as the spectrum of water-leaving radiances (Lw), i.e., the portion of visible - near infrared light that is reflected out of the water column, excluding light reflected at the surface. The inherent optical properties of absorption and scattering of surface waters (ocean optical properties) are derived from these Lw values. Water-leaving radiances are measured in W m^{-2} μm^{-1} sr^{-1}. Ocean optical properties, absorption and scattering, are estimated at each measured visible wavelength, and have units of inverse meters (m^{-1}). This product is required for clear daytime conditions only.

Offshore surface currents are defined as large-scale movements of the surface waters of the ocean farther than 100 km offshore.

Attribute	Threshold	Objective
3.4.13.10.2 *User & Priority Category*	NOS/ALL-2 NMFS/ALL-2	NOS/ALL-2 NMFS/ALL-2
3.4.13.10.3 *Geographic Coverage*	U.S. EEZ	U.S. EEZ
3.4.13.10.4 *Sensing Depth*	TBD	TBD
3.4.13.10.5 *Horizontal Resolution*	1 km	1 km
3.4.13.10.6 *Mapping Accuracy*	1 km	<1 km
3.4.13.10.7 *Measurement Range*	Absorption: 0.01 - 10 m^{-l} Scattering: 0.01 - 50 m^{-l} Chlorophyll fluorescence: n/a	Absorption: 0.005 - 20 m-l Scattering: 0.005 - 75 m-l Chlorophyll fluorescence: Detectable signal in waters with chlorophyll from 0.1 to 50 mg/m3 at 1 km resolution
3.4.13.10.8 *Measurement Accuracy*	<30% error	<30% error
3.4.13.10.9 *Refresh Rate*	24 hrs	60 min
3.4.13.10.10 *Data Latency*	60 min	30 min

3.4.13.11 SEA AND LAKE ICE / AGE: HEMISPHERIC

3.4.13.11.1 *Definition*

The age of the sea ice is usually a distinction between first-year and multiyear ice. Multiyear sea ice is usually thicker, has more ridges, and can be more of a hindrance to ship travel than first-year ice. [*Canadian Ice Service. See also Hall and Martinec*]

Attribute	Threshold	Objective
3.4.13.11.2 *User & Priority Category*	DoD/USA-1 DoD/USAF-1	DoD/USA-1 DoD/USAF-1
3.4.13.11.3 *Geographic Coverage*	Full Disk	Hemispheric
3.4.13.11.4 *Sensing Depth*	Ice Surface	Ice Surface
3.4.13.11.5 *Horizontal Resolution*	1 km	1 km
3.4.13.11.6 *Mapping Accuracy*	3 km	1 km
3.4.13.11.7 *Measurement Range*	Distinguish between ice free areas and first year ice.	Distinguish between Ice free, Nilas, Grey White, First Year Medium, First Year Thick, Second Year, and Multiyear Smooth and Deformed Ice
3.4.13.11.8 *Measurement Accuracy*	90%	95% (90% for sea Ice)
3.4.13.11.9 *Refresh Rate*	6 hours	180 min
3.4.13.11.10 *Data Latency*	60 min	15 min

3.4.13.12 SEA AND LAKE ICE / CONCENTRATION: CONUS

3.4.13.12.1 Definition

Concentration of the ice is defined as "The ratio expressed in tenths describing the amount of the sea surface covered by ice as a fraction of the whole area being considered. Total concentration includes all stages of development that are present. Partial concentration may refer to the amount of a particular stage or of a particular form of ice and represents only a part of the total." The concentration of sea ice varies within the ice pack due to deformation, new ice development, melting, breaking apart and ice motion. The motion of the ice is affected by various meteorological and oceanographic factors but primarily by the surface winds and surface ocean currents. The total concentration is expressed in tenths from 0/10s to 10/10s, either as a single number or as a range of numbers (e.g. 4 - 6/10s).

Attribute	Threshold	Objective
3.4.13.12.2 *User & Priority Category*	NESDIS/OSDPD/NIC - UA	NESDIS/OSDPD/NIC - UA
3.4.13.12.3 *Geographic Coverage*	CONUS/Regional - Great Lakes and US coastal waters containing sea ice hazards to navigation	CONUS/Regional - Great Lakes and US coastal waters containing sea ice hazards to navigation
3.4.13.12.4 *Sensing Depth*	Ice Surface	Ice Surface
3.4.13.12.5 *Horizontal Resolution*	3 km	1 km
3.4.13.12.6 *Mapping Accuracy*	≤ 1.5 km	≤ 1 km
3.4.13.12.7 *Measurement Range*	Ice concentration: 0/10 to 10/10	Ice concentration: 0/10 to 10/10
3.4.13.12.8 *Measurement Accuracy*	Ice extent 1 km Ice concentration: 10%	Ice extent 1 km Ice concentration: 10%
3.4.13.12.9 *Refresh Rate*	180 min	60 min
3.4.13.12.10 *Data Latency*	60 min	30 min

3.4.13.13 SEA AND LAKE ICE / CONCENTRATION: HEMISPHERIC

3.4.13.13.1 Definition

See requirement definition above.

Attribute	Threshold	Objective
3.4.13.13.2 *User & Priority Category*	NESDIS/OSDPD/NIC-1 DoD/USAF-1	NESDIS/OSDPD/NIC-1 DoD/USAF-1
3.4.13.13.3 *Geographic Coverage*	Full Disk - Sea ice covered waters in N. & S. Hemispheres	Global - Sea ice covered waters in N. & S. Hemispheres
3.4.13.13.4 *Sensing Depth*	Ice Surface	Ice Surface
3.4.13.13.5 *Horizontal Resolution*	10 km	5 km
3.4.13.13.6 *Mapping Accuracy*	≤ 5 km	≤ 2.5 km
3.4.13.13.7 *Measurement Range*	Ice concentration: 0/10 to 10/10	Ice concentration: 0/10 to 10/10
3.4.13.13.8 *Measurement Accuracy*	Ice extent 1 km Ice concentration: 10%	Ice extent 1 km Ice concentration: 10%
3.4.13.13.9 *Refresh Rate*	6 hours	180 min
3.4.13.13.10 *Data Latency*	180 min	30 min

3.4.13.14 SEA AND LAKE ICE / DISPLACEMENT AND DIRECTION: HEMISPHERIC

3.4.13.14.1 Definition

Refers to the magnitude/distance and direction of sea and lake ice fields or floes. Ice motion processes include: diverging, compacting, and shearing [*Canadian Ice Service; European Space Agency*].

Attribute	Threshold	Objective
3.4.13.14.2 *User & Priority Category*	NMFS/AKC/NMML-UA DoD/USAF-1	NMFS/AKC/NMML-UA DoD/USAF-1
3.4.13.14.3 *Geographic Coverage*	Full Disk	Hemispheric
3.4.13.14.4 *Horizontal Resolution*	10 km	1 km
3.4.13.14.5 *Mapping Accuracy*	10 km	1 km
3.4.13.14.6 *Measurement Range*	TBD	TBD
3.4.13.14.7 *Measurement Accuracy*	Direction: ± 22.5 deg.	Direction: ± 11.25 deg.
3.4.13.14.8 *Refresh Rate*	180 min	60 min
3.4.13.14.9 *Data Latency*	60 min	60 min and retrospective

3.4.13.15 SEA AND LAKE ICE / EXTENT AND EDGE: CONUS

3.4.13.15.1 Definition

Sea and lake ice extent is defined as the limit of the sea or lake ice, respectively, from the landmass to the ice edge (s). The Ice Edge is officially defined by the WMO (Pub. 259. 259TP145) as the "demarcation at any given time between the open sea and sea ice of any kind, whether fast or drifting." In practical terms, the ice edge marks the limit of all known ice. The ice edge is a critical region for safety of navigation and commerce.

Attribute		Threshold	Objective
3.4.13.15.2	*User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.4.13.15.3	*Geographic Coverage*	Great Lakes and US coastal waters containing sea ice hazards to navigation	Great Lakes and US coastal waters containing sea ice hazards to navigation
3.4.13.15.4	*Horizontal Resolution*	250 m	100 m
3.4.13.15.5	*Mapping Accuracy*	≤ 250 m	≤ 100 m
3.4.13.15.6	*Measurement Range*	Presence of Ice (day): Reflectance at 420-750 nm Presence of Ice (night): 10 - 12 μm	Presence of Ice (day): Reflectance at 420-750 nm Presence of Ice (night): 10 - 12 μm
3.4.13.15.7	*Measurement Accuracy*	10%	5%
3.4.13.15.8	*Refresh Rate*	180 min	60 min
3.4.13.15.9	*Data Latency*	60 min	30 min

3.4.13.16 SEA AND LAKE ICE / EXTENT AND EDGE: HEMISPHERIC

3.4.13.16.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.13.16.2	*User & Priority Category*	NESDIS/OSDPD/NIC-1 Climate-1	NESDIS/OSDPD/NIC-1 Climate-1
3.4.13.16.3	*Geographic Coverage*	FULL DISK - Sea ice covered waters in N. & S. Hemispheres	G - Sea ice covered waters in N. & S. Hemispheres
3.4.13.16.4	*Horizontal Resolution*	500 m	250 m
3.4.13.16.5	*Mapping Accuracy*	≤ 500 m	≤ 250 m
3.4.13.16.6	*Measurement Range*	Presence of Ice (day): Reflectance at 420-750 nm Presence of Ice (night): 10 - 12 μm	Presence of Ice (day): Reflectance at 420-750 nm Presence of Ice (night): 10 - 12 μm
3.4.13.16.7	*Measurement Accuracy*	10%	5%
3.4.13.16.8	*Refresh Rate*	6 hours	180 min
3.4.13.16.9	*Data Latency*	180 min	30 min

3.4.13.17 SEA AND LAKE ICE / EXTENT AND CHARACTERIZATION: HEMISPHERIC

3.4.13.17.1 Definition

Extent refers to the minimum or maximum length of the ice or ice edge into the open water. Also refers to the extent of the ice pack into the open ocean (which varies seasonally).

Characterization refers to the different ice types (newly formed ice versus first- and multi-year ice); physical properties (salinity, microstructure, moisture content and surface roughness); shape, size and location of the ice floes; and topographic features (ridges, rubble fields, etc.) [*Canadian Ice Service; European Space Agency*].

Attribute	Threshold	Objective
3.4.13.17.2 *User & Priority Category*	NMAO/Ships-2 DoD/USAF-1 DoD/USA-1	NMAO/Ships-2 DoD/USAF-1 DoD/USA-1
3.4.13.17.3 *Geographic Coverage*	TBD	Hemispheric
3.4.13.17.4 *Sensing Depth or Vertical Coverage*	TBD	surface
3.4.13.17.5 *Horizontal Resolution*	TBD	TBD
3.4.13.17.6 *Mapping Accuracy*	TBD	TBD
3.4.13.17.7 *Measurement Range*	TBD	TBD
3.4.13.17.8 *Measurement Accuracy*	TBD	TBD
3.4.13.17.9 *Refresh Rate*	TBD	60 min
3.4.13.17.10 *Data Latency*	TBD	15 min

3.4.13.18 SEA AND LAKE ICE / MOTION: CONUS

3.4.13.18.1 Definition

Sea and lake ice motion is the instantaneous measurement of the direction and magnitude of the movement of the ice. The direction of the ice motion is normally expressed as degrees from 1-360. The magnitude of the ice motion is normally expressed in meters per second or in nautical miles per hour.

Attribute	Threshold	Objective
3.4.13.18.2 *User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.4.13.18.3 *Geographic Coverage*	Great Lakes and Chesapeake and Delaware Bays	Great Lakes and Chesapeake and Delaware Bays
3.4.13.18.4 *Horizontal Resolution*	5 km	3 km
3.4.13.18.5 *Mapping Accuracy*	≤ 2.5 km	≤ 1 km
3.4.13.18.6 *Measurement Range*	Direction: 0 - 360 ° Displacement: 0 - 0.6 m/s	Direction: 0 - 360 ° Displacement: 0 - 0.6 m/s
3.4.13.18.7 *Measurement Accuracy*	Direction: ± 15 degrees	Direction: ± 10 degrees
3.4.13.18.8 *Refresh Rate*	180 min	60 min
3.4.13.18.9 *Data Latency*	60 min	30 min

3.4.13.19 SEA AND LAKE ICE / MOTION: HEMISPHERIC

3.4.13.19.1 Definition

See requirement definition above.

Attribute	Threshold	Objective
3.4.13.19.2 *User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.4.13.19.3 *Geographic Coverage*	Full Disk - Sea ice covered waters in N. & S. Hemispheres	Global - Sea ice covered waters in N. & S. Hemispheres
3.4.13.19.4 *Horizontal Resolution*	15 km	10 km
3.4.13.19.5 *Mapping Accuracy*	≤ 7.5 km	≤ 5 km
3.4.13.19.6 *Measurement Range*	Direction: 0 - 360 º Displacement: 0 - 0.6 m/s	Direction: 0 - 360 º Displacement: 0 - 0.6 m/s
3.4.13.19.7 *Measurement Accuracy*	Direction: ± 15 degrees	Direction: ± 10 degrees
3.4.13.19.8 *Refresh Rate*	6 hours	180 min
3.4.13.19.9 *Data Latency*	180 min	30 min

3.4.13.20 SEA AND LAKE ICE / SURFACE TEMPERATURE: CONUS

3.4.13.20.1 Definition

Measurements of the temperature of the sea ice and surrounding sea surface temperature [*Hall and Martinec*].

Attribute	Threshold	Objective
3.4.13.20.2 *User & Priority Category*	NESDIS/OSDPD/NIC – UA NWS/NCEP/OPC-1	NESDIS/OSDPD/NIC – UA NWS/NCEP/OPC-1
3.4.13.20.3 *Geographic Coverage*	Great Lakes and US coastal waters containing sea ice hazards to navigation	Great Lakes and US coastal waters containing sea ice hazards to navigation
3.4.13.20.4 *Horizontal Resolution*	0.25 km	0.1 km
3.4.13.20.5 *Mapping Accuracy*	≤ 0.25 km	≤ 0.1 km
3.4.13.20.6 *Measurement Range*	213 - 280 K	213 - 280 K
3.4.13.20.7 *Measurement Accuracy*	0.5 K	0.5 K
3.4.13.20.8 *Refresh Rate*	180 min	60 min
3.4.13.20.9 *Data Latency*	60 min	30 min

3.4.13.21 SEA AND LAKE ICE / SURFACE TEMPERATURE: HEMISPHERIC

3.4.13.21.1 Definition

See above requirement

Attribute	Threshold	Objective
3.4.13.21.2 *User & Priority Category*	NESDIS/OSDPD/NIC-1 NWS/NCEP/OPC-1 Europeans - UA	NESDIS/OSDPD/NIC-1 NWS/NCEP/OPC-1 Europeans - UA
3.4.13.21.3 *Geographic Coverage*	FULL DISK - Sea ice covered waters in N. & S. Hemispheres	Global - Sea ice covered waters in N. & S. Hemispheres
3.4.13.21.4 *Horizontal Resolution*	0.5 km	0.25 km
3.4.13.21.5 *Mapping Accuracy*	≤ 0.5 km	≤ 0.25 km
3.4.13.21.6 *Measurement Range*	213 - 280 K	213 - 280 K
3.4.13.21.7 *Measurement Accuracy*	0.5 K	0.5 K
3.4.13.21.8 *Refresh Rate*	6 hours	180 min
3.4.13.21.9 *Data Latency*	180 min	30 min

3.4.13.22 SEA AND LAKE ICE / THICKNESS: CONUS

3.4.13.22.1 *Definition*

Sea and lake ice thickness is the vertical thickness of an ice floe, sheet of ice or area of newly forming ice. The thickness is normally measured in centimeters. Optimally, ice thickness should be measured directly. Ice thickness can be inferred from the age or stage of development of the ice. Certain characteristics of the ice are captured from remotely sensed imagery. The shape of the ice floes; the appearance of the surface in reflected light (visible imagery); the temperature of the ice (infrared imagery); appearance of surface melting; frost flowers; topography, freeboard and fracturing (active radar imagery); and the emissivity values (passive microwave) are all valuable parameters that are used to gauge the stage of development. These parameters combine to estimate the thickness of the ice. The stage of development describes the properties of the sea ice that are determined by the thickness and age of the ice. The ice assumes various characteristics of elasticity, tensile strength and probability of deformation in certain ways. The danger to shipping increases as it thickens and ages. Due to its hardness and strength, ice that has lasted over at least one summer melt season assumes many of the characteristics of ice of land origin or icebergs making it very dangerous to shipping.

Attribute	Threshold	Objective
3.4.13.22.2 *User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.4.13.22.3 *Geographic Coverage*	CONUS/Regional - Great Lakes and US coastal waters containing sea ice hazards to navigation	CONUS/Regional - Great Lakes and US coastal waters containing sea ice hazards to navigation
3.4.13.22.4 *Sensing Depth or Vertical Coverage*	Ice Surface	Ice Surface
3.4.13.22.5 *Horizontal Resolution*	250 m	250 m
3.4.13.22.6 *Mapping Accuracy*	≤ 250 m	≤ 125 m
3.4.13.22.7 *Measurement Range*	Age: 0 - 3 yrs Thickness:0 - 6 m	Age: 0 - 3 yrs Thickness:0 - 6 m
3.4.13.22.8 *Measurement Accuracy*	Ice Stage: ± 30 cm	Ice Stage: ± 30 cm
3.4.13.22.9 *Refresh Rate*	180 min	60 min
3.4.13.22.10 *Data Latency*	60 min	30 min

3.4.13.23 SEA AND LAKE ICE / THICKNESS: HEMISPHERIC

3.4.13.23.1 *Definition*

See requirement definition above.

Attribute	Threshold	Objective
3.4.13.23.2 *User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.4.13.23.3 *Geographic Coverage*	FULL DISK - Sea ice covered waters in the Northern and Southern Hemispheres	Global - Sea ice covered waters in the Northern and Southern Hemispheres
3.4.13.23.4 *Sensing Depth or Vertical Coverage*	Ice Surface	Ice Surface
3.4.13.23.5 *Horizontal Resolution*	500 m	250 m
3.4.13.23.6 *Mapping Accuracy*	≤ 500 m	≤ 250 m
3.4.13.23.7 *Measurement Range*	Age: 0 - 3 yrs Thickness: 0 - 6 m	Age: 0 - 3 yrs Thickness: 0 - 6 m
3.4.13.23.8 *Measurement Accuracy*	Ice Stage: ± 30 cm	Ice Stage: ± 30 cm
3.4.13.23.9 *Refresh Rate*	6 hours	180 min
3.4.13.23.10 *Data Latency*	180 min	30 min

3.4.13.24 SEA SURFACE TEMPERATURE: CONUS / OFFSHORE

3.4.13.24.1 *Definition*

The skin temperature of the ocean at depths on the order of 10 μm.

Offshore surface currents are defined as large-scale movements of the surface waters of the ocean farther than 100 km offshore.

Attribute	Threshold	Objective
3.4.13.24.2 *User & Priority Category*	NOS/ALL-1 NWS/NCEP/OPC-1 NMFS/All-1 NESDIS/OSDPD/NIC-1	NOS/ALL-1 NWS/NCEP/OPC-1 NMFS/All-1 NESDIS/OSDPD/NIC-1
3.4.13.24.3 *Geographic Coverage*	CONUS & U.S. navigable waters thru EEZ	CONUS & U.S. navigable waters thru EEZ
3.4.13.24.4 *Horizontal Resolution*	2 km	0.5 km
3.4.13.24.5 *Mapping Accuracy*	1.0 km	≤ 0.1 km
3.4.13.24.6 *Measurement Range*	270 - 313 K	243 - 313 K
3.4.13.24.7 *Measurement Accuracy*	1 K	0.1 K
3.4.13.24.8 *Refresh Rate*	180 min	15 min
3.4.13.24.9 *Data Latency*	60 min	5 min

3.4.13.25 SEA SURFACE TEMPERATURE: HEMISPHERIC

3.4.13.25.1 Definition

See requirement definition above.

Attribute	Threshold	Objective
3.4.13.25.2 *User & Priority Category*	NESDIS/ORA-1 NMFS/All-1 NWS/NCEP/OPC-1 Climate-2 NMAO/Ships-2 Europeans – UA DoD/USAF-1	NESDIS/ORA-1 NMFS/All-1 NWS/NCEP/OPC-1 Climate-2 NMAO/Ships-2 Europeans – UA DoD/USAF-1
3.4.13.25.3 *Geographic Coverage*	Full Disk	Hemispheric
3.4.13.25.4 *Horizontal Resolution*	2 km	0.5 km
3.4.13.25.5 *Mapping Accuracy*	1.0 km	0.2 km
3.4.13.25.6 *Measurement Range*	271 - 313 K	271 - 313 K
3.4.13.25.7 *Measurement Accuracy*	1 K	0.1 K
3.4.13.25.8 *Refresh Rate*	60 min	15 min
3.4.13.25.9 *Data Latency*	15 min	5 min
3.4.13.25.10 *Long-term Stability*	TBD	0.04 K

3.4.13.26 SEA SURFACE TEMPERATURE: MESOSCALE

3.4.13.26.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.4.13.26.2	*User & Priority Category*	NWS/NCEP/OPC-1	NWS/NCEP/OPC-1
3.4.13.26.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.4.13.26.4	*Horizontal Resolution*	2 km	0.5 km
3.4.13.26.5	*Mapping Accuracy*	1.0 km	0.2 km
3.4.13.26.6	*Measurement Range*	270 - 313 K	270 - 313 K
3.4.13.26.7	*Measurement Accuracy*	1 K	1 K
3.4.13.26.8	*Refresh Rate*	60 min	15 min
3.4.13.26.9	*Data Latency*	15 min	5 min

3.4.14 Performance Characteristics: Space / Energetic Particles

3.4.14.1 ENERGETIC HEAVY IONS

3.4.14.1.1 Definition

Measurement of energetic heavy ions.

Attribute		Threshold	Objective
3.4.14.1.2	*User & Priority (LO-#)*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.14.1.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	1 direction (TBD)	1 direction (TBD)
3.4.14.1.4	*Measurement Range*	10 - 200 MeV/n (TBD) 4 mass groups: He, (C,N,O), Ne-S & Fe	10 - 200 MeV/n - (TBD) 4 mass groups: He, (C,N,O), Ne-S & Fe
3.4.14.1.5	*Measurement Accuracy*	25%	10% (TBD)
3.4.14.1.6	*Refresh Rate*	5 min	5 min
3.4.14.1.7	*Data Latency*	5 min	5 min

3.4.14.2 MAGNETOSPHERIC ELECTRONS AND PROTONS: LOW ENERGY

3.4.14.2.1 Definition

Measurement of the low energy magnetospheric particles.

Attribute		Threshold	Objective
3.4.14.2.2	*User & Priority*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.14.2.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	5 directions	9 directions
3.4.14.2.4	*Measurement Range*	Electrons and Protons: 30 eV – 30 keV	Electrons and Protons: 30 eV – 30 keV
3.4.14.2.5	*Measurement Accuracy*	25%	10% (TBD)
3.4.14.2.6	*Refresh Rate*	30 sec	10 sec
3.4.14.2.7	*Data Latency*	1 min	1 min

3.4.14.3 MAGNETOSPHERIC ELECTRONS AND PROTONS: MEDIUM AND HIGH ENERGY

3.4.14.3.1 Definition

Measurement of the medium- and high-energy magnetospheric particles.

Attribute		Threshold	Objective
3.4.14.3.2	*User & Priority Category*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.14.3.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	5 directions (TBD)	9 directions (TBD)
3.4.14.3.4	*Measurement Range*	Electrons: 30 keV - 4 MeV Protons: 30 keV - 1MeV	Electrons: 30 keV - 4 MeV Protons: 30 keV - 1MeV
3.4.14.3.5	*Measurement Accuracy*	25%	10%
3.4.14.3.6	*Refresh Rate*	30 sec	10 sec
3.4.14.3.7	*Data Latency*	1 min	1 min

3.4.14.4 SOLAR AND GALACTIC PROTONS

3.4.14.4.1 Definition

Measurement of the solar energetic protons and galactic cosmic ray protons.

Attribute		Threshold	Objective
3.4.14.4.2	*User & Priority Category*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.14.4.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	2 directions	2 directions
3.4.14.4.4	*Measurement Range*	1 MeV – 500 MeV, Differential Measurements	1 MeV – 500 MeV, Differential Measurements; One integral measurement between 500 MeV - 1 GeV
3.4.14.4.5	*Measurement Accuracy*	25%	10%
3.4.14.4.6	*Refresh Rate*	1 min	30 sec
3.4.14.4.7	*Data Latency*	1 min	1 min

3.4.15 Performance Characteristics: Space / Magnetic Field

3.4.15.1 GEOMAGNETIC FIELD

3.4.15.1.1 Definition

Measurement of earth's magnetic field and its variations at geosynchronous orbit.

Attribute		Threshold	Objective
3.4.15.1.2	*User & Priority Category*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.15.1.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	3-axis 0.5 deg	3-axis 0.5 deg
3.4.15.1.4	*Orientation Stability/Mapping Accuracy*	±0.25 deg (TBD)	±0.25 deg (TBD)
3.4.15.1.5	*Orientation Knowledge*	±1 deg	±0.5 deg
3.4.15.1.6	*Measurement Range*	≥ ± 400 nT/axis (3-axis vector)	≥ ± 400 nT/axis (3-axis vector)
3.4.15.1.7	*Measurement Accuracy*	1.0 nT (per axis)	1.0 nT (per axis)
3.4.15.1.8	*Refresh Rate*	2 samples /sec	8 samples /sec
3.4.15.1.9	*Data Latency*	RT (5s)	RT (5s)

3.4.16 Performance Characteristics: Space / Solar

3.4.16.1 SOLAR FLUX: EUV

3.4.16.1.1 Definition

Measurement of the disk-integrated solar extreme ultraviolet flux between 1.0 and 129 nm wavelength.

Attribute		Threshold	Objective
3.4.16.1.2	*User & Priority Category*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.16.1.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	Solar Disk (40 arcmin)	Solar Disk (40 arcmin)
3.4.16.1.4	*Mapping Accuracy*	±2 arcmin accuracy with ±1 arcmin resolution when within 2^o of Sun-center	±2 arcmin accuracy with ±1 arcmin resolution when within 2^o of Sun-center
3.4.16.1.5	*Mapping Uncertainty*	±2 arcmin	±2 arcmin
3.4.16.1.6	*Measurement Range*	0.1x Sol Min 10x Sol Max	0.1x Sol Min 10x Sol Max
3.4.16.1.7	*Measurement Accuracy*	± 10%	± 5%
3.4.16.1.8	*Refresh Rate*	30 sec	10 sec
3.4.16.1.9	*Data Latency*	30 sec	10 sec
3.4.16.1.10	*Long-term Stability*	<5% over mission	<2% over mission

3.4.16.2 SOLAR FLUX: X-RAY

3.4.16.2.1 Definition

Measurement of the disk-integrated Solar X-ray flux between 0.05 and 0.8 nm in wavelength.

Attribute		Threshold	Objective
3.4.16.2.2	*User & Priority Category*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.16.2.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	Solar Disk (40 arcmin)	Solar Disk (40 arcmin)
3.4.16.2.4	*Mapping Accuracy*	±2 arcmin accuracy with ± 1 arcmin resolution when within 2^o of Sun-center	±2 arcmin accuracy with ± 1 arcmin resolution when within 2^o of Sun-center
3.4.16.2.5	*Mapping Uncertainty*	± 2 arcmin	± 2 arcmin
3.4.16.2.6	*Measurement Range*	XRSA: $5x10^{-9}$ to $5x10^{-4}$ W/m^2 XRSB: $2x10^{-8}$ to $2x10^{-3}$ W/m^2	XRSA: $1x10^{-9}$ to $1x10^{-3}$ W/m^2 XRSB: $1x10^{-8}$ to $4x10^{-3}$ W/m^2
3.4.16.2.7	*Measurement Accuracy*	±10%	± 5%
3.4.16.2.8	*Refresh Rate*	3 sec	0.5 sec
3.4.16.2.9	*Data Latency*	3 sec	3 sec
3.4.16.2.10	*Long-term Stability*	< 5 % over mission	< 5 % over mission

3.4.16.3 SOLAR IMAGERY: X-RAY

3.4.16.3.1 Definition

Solar images at wavelengths between 0.6 and 6 nm.

Attribute		Threshold	Objective
3.4.16.3.2	*User & Priority Category*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.4.16.3.3	*Orthogonality/Angular Resolution/Spatial or Geographic Coverage*	0.0 -1.3 solar radii	0.0 -1.3 solar radii
3.4.16.3.4	*Spatial/Horizontal/Angular Resolution*	7.0 arcsec	5.0 arcsec
3.4.16.3.5	*Mapping Accuracy*	Stability during 24 hrs: ±1.0 arcmin (N-S, E-W) Stability during exposure: ±1.0 arcsec (E-W) ±1.0 arcsec (N-S) Control: ±15.0 arcsec	Stability during 24 hrs: ±1.0 arcmin (N-S, E-W) Stability during exposure: ±1.0 arcsec (E-W) ±1.0 arcsec (N-S) Control: ±15.0 arcsec
3.4.16.3.6	*Mapping Uncertainty*	±2.5 arcsec	±2.5 arcsec
3.4.16.3.7	*Measurement Range*	Radiance: 0.3-10^6 ph/cm^2/arcsec/ sec Temperature: 1-10 MK (TBD)	Radiance: 0.3-10^6 ph/cm^2/arcsec/ sec Temperature: 0.5 - 20 MK (TBD)
3.4.16.3.8	*Measurement Accuracy*	± 20 % in radiance	± 10 % in radiance
3.4.16.3.9	*Refresh Rate*	Image < 2 min Temperature < 6 min	Image < 1 min Temperature < 3 min
3.4.16.3.10	*Data Latency*	< 1 min	< 1 min
3.4.16.3.11	*Long Term Stability*	20%	20%

3.5 PRE-PLANNED PRODUCT IMPROVEMENTS (P^3I) REQUIREMENTS

The purpose is to facilitate the early fielding of a GOES-R system, which can fulfill the vast majority of the designated mission requirements and includes a plan to incorporate improvements to the system after initial fielding. P^3I will allow the fielding of GOES-R by the IOC need date and, eventually, significantly more of the capability desired by the GOES-R user community. It also reduces program risk and up-front program costs. P^3I includes programming resources to accomplish an orderly and cost-effective evolution of a system's capability after fielding. The objectives of P^3I are:

- Introduction of higher technological performance during system lifetime through more rapid fielding of technological advances
- Shortening of acquisition and deployment times
- Reduction in system technical, cost and schedule risk
- Extension of system useful life (preventing early obsolescence)
- Reduction of requirements for major system new starts
- Improvement of system operational readiness during the system's lifetime

This approach will allow the GOES-R PM to develop and produce the basic system while pursuing the technologies required for improvements in parallel with the basic system. This means that funding for the development of the incremental upgrades are part of the original programs funding line and are not handled as a new start. For this iteration of the GPRD, Version I, funding for the P^3I requirements are not included in the current GOES R program budget. Rather they are being studied for future consideration and possible inclusion in the GOES R program budget. The decision as to which P^3I requirements will be included in the program budget will occur with the approval of GPRD Version II.

Individual Products that are in the P^3I category are identified in the following sub-sections.

3.5.1 Performance Characteristics: Atmosphere / Aerosols

3.5.1.1 AEROSOL PARTICLE SIZE: GLOBAL

3.5.1.1.1 Definition

Measurement of the bimodal size distribution of the aerosol population in terms of the effective radius r_e and effective variance v_e of each mode. The effective radius is the ratio of the third moment of the aerosol size distribution to the second moment. The effective variance characterizes the width of the size distribution. The refresh requirement for the climate products is to provide observations from the satellite nadir-track of any satellite carrying the aerosol polarimeter. The requirements below apply only under clear conditions.

3.5.1.1.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.1.1.3	*User & Priority (LO-#)*	DoD/USN&USMC-1	DoD/USN&USMC-1
3.5.1.1.4	*Geographic Coverage*	Global	Global
3.5.1.1.5	*Vertical Resolution*	Sfc - 4.5 km:150 m >4.5 km: 300 m	TBS
3.5.1.1.6	*Horizontal Resolution*	10 km	TBS
3.5.1.1.7	*Mapping Accuracy*	TBS	TBS
3.5.1.1.8	*Measurement Range*	0 - 30 km	TBS
3.5.1.1.9	*Measurement Accuracy*	Sfc - 4.5 km: ±0.5 >4.5 km: ±1.0	greater of 0.1 or 10% / 0.1
3.5.1.1.10	*Refresh Rate/Coverage Time*	60 min	TBS
3.5.1.1.11	*Data Latency*	15 min	TBS

3.5.1.2 SUSPENDED MATTER: GLOBAL

3.5.1.2.1 Definition

Fine solids suspended in the air. The threshold content of this observational requirement is to report the presence of suspended matter such as dust, sand, volcanic ash, SO_2, or smoke at any altitude.

3.5.1.2.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.1.2.3	*User & Priority (LO-#)*	NWS/NCEP/OPC-3 DoD/USAF-1 Europeans-UA	NWS/NCEP/OPC-3 DoD/USAF-1 Europeans-UA
3.5.1.2.4	*Geographic Coverage*	Global	Global
3.5.1.2.5	*Vertical Resolution*	Total Column	Total Column
3.5.1.2.6	*Horizontal Resolution*	2 km	0.5 km
3.5.1.2.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.1.2.8	*Measurement Range*	TBS	TBS
3.5.1.2.9	*Measurement Accuracy*	TBS	Troposphere / Stratosphere: 0.01 / 0.01
3.5.1.2.10	*Refresh Rate/Coverage Time*	15 min	5 min
3.5.1.2.11	*Data Latency*	3 min	1 min

3.5.2 Performance Characteristics: Atmosphere / Clouds

3.5.2.1 CLOUD BASE HEIGHT: GLOBAL

3.5.2.1.1 Definition

Height above ground level where cloud bases occur. For a given cloud or cloud layer, the lowest height in the atmosphere at which the air contains a perceptible quantity of cloud particles [*Glossary of Meteorology*].

3.5.2.1.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.1.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 DoD/USAF-1 Europeans -UA	Climate-1 NWS/NCEP/OPC-1 DoD/USAF-1 Europeans -UA
3.5.2.1.4	*Geographic Coverage*	Global	Global
3.5.2.1.5	*Vertical Resolution*	0.5 km	0.5 km
3.5.2.1.6	*Horizontal Resolution*	2 km	1 km
3.5.2.1.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.2.1.8	*Measurement Range*	0 – 15 km	0 – 30 km
3.5.2.1.9	*Measurement Accuracy*	0.1 km	0.1 km
3.5.2.1.10	*Refresh Rate/Coverage Time*	15 min	5 min
3.5.2.1.11	*Data Latency*	1 min	1 min
3.5.2.1.12	*Long-term Stability*	TBS	0.1 km

3.5.2.2 CLOUD ICE WATER PATH: GLOBAL

3.5.2.2.1 Definition

A measure of the equivalent water mass of the ice particles in a unit vertical column through the cloud. Measured information is dependent on the number of particles, their sizes, and their densities.

3.5.2.2.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.2.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-3	Climate-1 NWS/NCEP/OPC-3
3.5.2.2.4	*Geographic Coverage*	Global	Global
3.5.2.2.5	*Vertical Resolution*	SFC – 20 km	SFC – 20 km
3.5.2.2.6	*Horizontal Resolution*	2 km	0.5 km
3.5.2.2.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.2.2.8	*Measurement Range*	0 –1 mm	0 – 2 mm
3.5.2.2.9	*Measurement Accuracy*	Greater of 0.1 mm or 25%	Greater of 0.05 mm or 10%
3.5.2.2.10	*Refresh Rate/Coverage Time*	15 min	15 min
3.5.2.2.11	*Data Latency*	1 min	1 min
3.5.2.2.12	*Long-term Stability*	15 min	15 min

3.5.2.3 CLOUD LAYERS / HEIGHTS AND THICKNESS: GLOBAL

3.5.2.3.1 Definition

The heights of the cloud layer bases above local terrain or above mean sea level. Cloud layer thickness is defined as the vertical distance from the cloud base to the cloud top; more commonly referred to as the "thickness" or "depth" of the cloud [*Glossary of Weather and Climate*].

3.5.2.3.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.3.3	*User & Priority (LO-#)*	Climate-1 DoD/USA-1 DoD/USN-USMC-1	Climate-1 DoD/USA-1 DoD/USN-USMC-1
3.5.2.3.4	*Geographic Coverage*	Global	Global
3.5.2.3.5	*Vertical Resolution*	Sfc - 1.5 km: 30 km 1.5-3 km: 150m >3km: 300 m	Sfc - 2 km: 30 km 2 - 20 km: 150m >3km: 300 m
3.5.2.3.6	*Horizontal Resolution*	100 km	25 km
3.5.2.3.7	*Mapping Accuracy*	TBS	TBS
3.5.2.3.8	*Measurement Range*	0 – 50 km	0 – 20 km
3.5.2.3.9	*Measurement Accuracy*	TBS	TBS
3.5.2.3.10	*Refresh Rate/Coverage Time*	TBS	TBS
3.5.2.3.11	*Data Latency*	TBS	TBS

3.5.2.4 CLOUD LIQUID WATER: GLOBAL

3.5.2.4.1 Definition

Cloud Liquid Water is the amount of liquid water per unit volume of air [*Atmospheric Science: An Introductory Survey*].

3.5.2.4.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.4.3	*User & Priority (LO-#)*	Climate-1 DoD/USAF – 1 Europeans - UA	Climate-1 DoD/USAF – 1 Europeans - UA
3.5.2.4.4	*Geographic Coverage*	Global	Global
3.5.2.4.5	*Vertical Resolution*	TBS	TBS
3.5.2.4.6	*Horizontal Resolution*	100 km	25 km
3.5.2.4.7	*Mapping Accuracy*	TBS	TBS
3.5.2.4.8	*Measurement Range*	TBS	TBS
3.5.2.4.9	*Measurement Accuracy*	TBS	0.0.025 mm
3.5.2.4.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.2.4.11	*Data Latency*	TBS	TBS
3.5.2.4.12	*Long-term Stability*	TBS	0.005 mm

3.5.2.5 CLOUD AND MOISTURE IMAGERY: GLOBAL

3.5.2.5.1 Definition

The requirement is for:

- All weather, day/night imagery of selected regions
- Low-light imagery - using reflected moonlight - visible near infrared (VNIR) portion of the spectrum, typically 0.4 - 1.5 μm
  Reference: From the USGS table included below, for example, the VIS is 0.4 - 0.7 μm and the NIR is 0.7 - 1.5 μm
- Imagery within the thermal or infrared portion of the spectrum (typically 1.5 μm - 1.0 μm)
  Reference: Same as above
- Specialized imagery within the visible portion of the spectrum (typically 0.4 - 0.7 μm)
  - Near, Shortwave Infrared, Water Vapor - 500 mb, Water Vapor - 30 mb, Infrared Window, Infrared "dirty" Window, Infrared CO_2

Specialized imagery is required at sufficient resolution to enable discernment of environmental phenomena (by either manual analysis or automated algorithms) within the visible portion of the spectrum (typically, 0.4 - 0.7 μm). The cloud and moisture imagery shall be able to depict clouds, water vapor, lights from human settlements, fires, gas flares, and heavily lit fishing boats. Environmental phenomena range in size from cloud types and elements to planetary scale planetary scale (10^7 km^2) weather patterns [*Intergovernmental Panel on Climate Change*]. The cloud and moisture imagery shall provide digital input, through single bands and/or combinations of band/channels, to remote sensing algorithms that produce other environmental measurements, although this does not replace the explicit requirement for retrieval of individual parameters described elsewhere in this document.

3.5.2.5.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.5.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 DoD/USA-1 DoD/USN-USMC-1 Europeans - UA	Climate-1 NWS/NCEP/OPC-1 DoD/USA-1 DoD/USN-USMC-1 Europeans - UA
3.5.2.5.4	*Geographic Coverage*	Global	Global
3.5.2.5.5	*Horizontal Resolution*	0.5 km	0.2 km
3.5.2.5.6	*Mapping Accuracy*	0.5 km	0.2 km
3.5.2.5.7	*Measurement Range*	TBS	TBS
3.5.2.5.8	*Measurement Accuracy*	TBS	0.01 (Cloud Fraction)
3.5.2.5.9	*Refresh Rate/Coverage Time*	15 min	15 min
3.5.2.5.10	*Data Latency*	1 min	1 min
3.5.2.5.11	*Long-term Stability*	TBS	0.003 (Cloud Fraction)

3.5.2.6 CLOUD OPTICAL DEPTH: GLOBAL

3.5.2.6.1 Definition

The degree to which a cloud prevents light from passing through it. The vertical optical thickness between the top and bottom of a cloud.

Cloud optical depths are relatively independent of wavelength throughout the visible spectrum, but rise rapidly in the infrared due to absorption by water, and many clouds approximate blackbodies in the thermal infrared. In the visible portion of the spectrum, the cloud optical depth is almost entirely due to scattering by droplets or crystals, and ranges through orders of magnitude from low values less than 0.1 for thin cirrus to over 1000 for a large cumulonimbus. Cloud optical depths depend directly on the cloud thickness, the liquid or ice water content, and the size distribution of the water droplets or ice crystals. Optical thickness depends upon the physical constitution (crystals, drop, droplets), the form, the concentration of particles, and the vertical extent of the cloud [*Glossary of Meteorology*].

3.5.2.6.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.6.3	*User & Priority (LO-#)*	Climate-1	Climate-1
3.5.2.6.4	*Geographic Coverage*	Global	Global
3.5.2.6.5	*Vertical Resolution*	TBS	TBS
3.5.2.6.6	*Horizontal Resolution*	100 km	25 km
3.5.2.6.7	*Mapping Accuracy*	TBS	TBS
3.5.2.6.8	*Measurement Range*	TBS	TBS
3.5.2.6.9	*Measurement Accuracy*	TBS	10%
3.5.2.6.10	*Refresh Rate*	60 min	15 min
3.5.2.6.11	*Data Latency*	TBS	TBS
3.5.2.6.12	*Long-term Stability*	TBS	2%

3.5.2.7 CLOUD PARTICLE SIZE DISTRIBUTION: GLOBAL

3.5.2.7.1 Definition

The effective radius r_e and effective variance v_e of a single mode particle size distribution. The effective radius is the ratio of the third moment of the size distribution to the second moment. The effective variance characterizes the width of the size distribution. The refresh requirement for the climate products is to provide observations from the satellite nadir-track of any satellite carrying the aerosol polarimeter [*Integrated Operational Requirements Document*].

3.5.2.7.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.7.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-3 DoD/USN-USMC-1 Europeans – UA	Climate-1 NWS/NCEP/OPC-3 DoD/USN-USMC-1 Europeans – UA
3.5.2.7.4	*Geographic Coverage*	Global	Global
3.5.2.7.5	*Vertical Resolution*	TBS	TBS
3.5.2.7.6	*Horizontal Resolution*	2 km	0.5 km
3.5.2.7.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.2.7.8	*Measurement Range*	0 - 50 μm	0 - 100 μm
3.5.2.7.9	*Measurement Accuracy*	1 μm	0 .5 μm
3.5.2.7.10	*Refresh Rate/Coverage Time*	15 min	15 min
3.5.2.7.11	*Data Latency*	1 min	1 min
3.5.2.7.12	*Long-term Stability*	TBS	TBS

3.5.2.8 CLOUD TOP HEIGHT: GLOBAL

3.5.2.8.1 Definition

The height of the cloud top above local terrain or above mean sea level. [*Glossary of Weather and Climate*]

3.5.2.8.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.8.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-2 DoD/USAF-1 Europeans - UA	Climate-1 NWS/NCEP/OPC-2 DoD/USAF-1 Europeans - UA
3.5.2.8.4	*Geographic Coverage*	Global	Global
3.5.2.8.5	*Vertical Resolution*	0.1 km	0.1 km
3.5.2.8.6	*Horizontal Resolution*	2 km	0.5 km
3.5.2.8.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.2.8.8	*Measurement Range*	TBS	TBS
3.5.2.8.9	*Measurement Accuracy*	TBS	150 m
3.5.2.8.10	*Refresh Rate/Coverage Time*	15 min	15 min
3.5.2.8.11	*Data Latency*	1 min	1 min
3.5.2.8.12	*Long-term Stability*	TBS	30 m

3.5.2.9 CLOUD TOP PHASE: GLOBAL

3.5.2.9.1 Definition

The state of aggregation of a cloud, for example, solid, liquid, or gas [*Glossary of Meteorology*].

3.5.2.9.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.9.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-3	Climate-1 NWS/NCEP/OPC-3
3.5.2.9.4	*Geographic Coverage*	Global	Global
3.5.2.9.5	*Vertical Resolution*	TBS	TBS
3.5.2.9.6	*Horizontal Resolution*	2 km	0.5 km
3.5.2.9.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.2.9.8	*Measurement Range*	TBS	TBS
3.5.2.9.9	*Measurement Accuracy*	TBS	TBS
3.5.2.9.10	*Refresh Rate/Coverage Time*	15 min	5 min
3.5.2.9.11	*Data Latency*	1 min	1 min
3.5.2.9.12	*Long-term Stability*	TBS	TBS

3.5.2.10 CLOUD TOP PRESSURE: GLOBAL

3.5.2.10.1 Definition

Atmospheric pressure observed at the top of a cloud [*NASA's Global Change Master Directory (GCMD)*].

3.5.2.10.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.10.3	*User & Priority (LO-#)*	Climate-1	Climate-1
3.5.2.10.4	*Geographic Coverage*	Global	Global
3.5.2.10.5	*Vertical Resolution*	TBS	TBS
3.5.2.10.6	*Horizontal Resolution*	100 km	25 km
3.5.2.10.7	*Mapping Accuracy*	TBS	TBS
3.5.2.10.8	*Measurement Range*	TBS	TBS
3.5.2.10.9	*Measurement Accuracy*	TBS	15 hPa
3.5.2.10.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.2.10.11	*Data Latency*	TBS	TBS
3.5.2.10.12	*Long-term Stability*	TBS	3 hPa

3.5.2.11 CLOUD TOP TEMPERATURE: GLOBAL

3.5.2.11.1 Definition

Measurement of temperature at the top of the highest cloud layer as a threshold, at the top of all cloud layers as an objective.

3.5.2.11.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.11.3	*User & Priority (LO-#)*	Climate-1 DoD/USAF-1	Climate-1 DoD/USAF-1
3.5.2.11.4	*Geographic Coverage*	TBS	Global
3.5.2.11.5	*Vertical Resolution*	TBS	TBS
3.5.2.11.6	*Horizontal Resolution*	100 km	25 km
3.5.2.11.7	*Mapping Accuracy*	TBS	TBS
3.5.2.11.8	*Measurement Range*	TBS	TBS
3.5.2.11.9	*Measurement Accuracy*	TBS	1 K
3.5.2.11.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.2.11.11	*Data Latency*	TBS	TBS
3.5.2.11.12	*Long-term Stability*	TBS	0.2 K

3.5.2.12 CLOUD TYPE: GLOBAL

3.5.2.12.1 Definition

The main characteristic form of a cloud used in its identification. Also known as cloud genus [*Glossary of Weather and Climate*].

3.5.2.12.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.12.3	*User & Priority (LO-#)*	Climate-1 DoD/USA-1 DoD/USN-USMC-1	Climate-1 DoD/USA-1 DoD/USN-USMC-1
3.5.2.12.4	*Geographic Coverage*	Global	Global
3.5.2.12.5	*Horizontal Resolution*	100 km	15 km
3.5.2.12.6	*Mapping Accuracy*	TBS	TBS
3.5.2.12.7	*Measurement Range*	TBS	TBS
3.5.2.12.8	*Measurement Accuracy*	TBS	TBS
3.5.2.12.9	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.2.12.10	*Data Latency*	TBS	TBS
3.5.2.12.11	*Long-term Stability*	TBS	TBS

3.5.2.13 IMAGERY: ALL-WEATHER/DAY-NIGHT: GLOBAL

3.5.2.13.1 Definition

All weather day/night imagery of selected regions. Imagery shall allow discernment of environmental phenomena, including sea ice (by either manual analysis or automated algorithms) and provide digital input to remote sensing algorithms that produce other environmental parameters [*Integrated Operational Requirements Document*].

3.5.2.13.2 P³I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.13.3	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.5.2.13.4	*Geographic Coverage*	Global	Global – All Weather
3.5.2.13.5	*Horizontal Resolution*	TBS	0.1 km
3.5.2.13.6	*Mapping Accuracy*	TBS	0.5 km
3.5.2.13.7	*Measurement Range*	TBS	TBS
3.5.2.13.8	*Measurement Accuracy*	TBS	TBS
3.5.2.13.9	*Refresh Rate/Coverage Time*	TBS	60 min
3.5.2.13.10	*Data Latency*	TBS	15 min

3.5.2.14 LIGHTNING DETECTION: GLOBAL

3.5.2.14.1 Definition

The location of air-to-air and air-to-ground lightning strikes.

Attribute		Threshold	Objective
3.5.2.14.2	*User & Priority (LO-#)*	NWS/NCEP/OPC-1	NWS/NCEP/OPC-1
3.5.2.14.3	*Geographic Coverage*	Global	Global
3.5.2.14.4	*Vertical Resolution*	Surface to cloud top	Surface to cloud top
3.5.2.14.5	*Horizontal Resolution*	10 km	1 km
3.5.2.14.6	*Mapping Accuracy*	1 km	100 m
3.5.2.14.7	*Measurement Range*	Real time	Real time
3.5.2.14.8	*Measurement Accuracy*	70-90% total strikes detection ± 15 Flashes/min 20% False Alarm Rate	99% total strikes detection
3.5.2.14.9	*Refresh Rate*	continuous	continuous
3.5.2.14.10	*Data Latency*	1 min	<10 sec

3.5.2.15 TRUE COLOR IMAGERY

3.5.2.15.1 Definition

Images of the visible and near infrared part of the electromagnetic spectrum to which a "dark correction" and "Rayleigh correction" are applied; the data are calibrated, co-registered; and then the data are displayed as a "True Color" image [*SeaWifs Teachers Resources*].

3.5.2.15.2 P³I Justification

To address this requirement an additional visible imagery channel is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.15.3	*User & Priority (LO-#)*	NESDIS/ORA-3	NESDIS/ORA-3
3.5.2.15.4	*Geographic Coverage*	Hemispheric	Global
3.5.2.15.5	*Vertical Resolution*	TBS	TBS
3.5.2.15.6	*Horizontal Resolution*	2 km	0.5 km
3.5.2.15.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.2.15.8	*Measurement Range*	TBS	TBS
3.5.2.15.9	*Measurement Accuracy*	TBS	TBS
3.5.2.15.10	*Refresh Rate/Coverage Time*	60 min	5 min
3.5.2.15.11	*Data Latency*	TBS	TBS

3.5.2.16 TURBULENCE: GLOBAL

3.5.2.16.1 Definition

A state of fluid flow in which the instantaneous (wind) velocities exhibit irregular and apparently random fluctuations so that in practice only statistical properties can be recognized and subjected to analysis [*Glossary of Weather and Climate*].

3.5.2.16.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.16.3	*User & Priority (LO-#)*	DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1	DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1
3.5.2.16.4	*Geographic Coverage*	Global	Global
3.5.2.16.5	*Vertical Resolution*	TBS	60 m
3.5.2.16.6	*Horizontal Resolution*	TBS	10 km
3.5.2.16.7	*Mapping Accuracy*	TBS	5 km
3.5.2.16.8	*Measurement Range*	TBS	0 - 40 m/s
3.5.2.16.9	*Measurement Accuracy*	TBS	±1 m/s
3.5.2.16.10	*Refresh Rate/Coverage Time*	TBS	180 min
3.5.2.16.11	*Data Latency*	TBS	15 min

3.5.2.17 VISIBILITY: GLOBAL

3.5.2.17.1 Definition

Visibility is the clarity with which an object may be seen. It is the greatest distance in a given direction at which it is just possible to see and identify with the unaided eye:

1) in the daytime a prominent dark object against the sky at the horizon, and
2) at night, a known, preferably unfocused, moderately intense light source.

[*Glossary of Meteorology*]

3.5.2.17.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.2.17.3	*User & Priority (LO-#)*	DoD/USN-USMC-1 DoD/USAF-1	DoD/USN-USMC-1 DoD/USAF-1
3.5.2.17.4	*Geographic Coverage*	Hemispheric	Global
3.5.2.17.5	*Vertical Resolution*	Sfc-4.5 km: 150 m > 4.5 km: 300 m	Sfc-4.5 km: 150 m > 4.5 km: 300 m
3.5.2.17.6	*Horizontal Resolution*	10 km	10 km
3.5.2.17.7	*Mapping Accuracy*	TBS	2 km
3.5.2.17.8	*Measurement Range*	0 - 30 km	0 - 30 km
3.5.2.17.9	*Measurement Accuracy*	0-15 km: ± 2% 15-60 km: ± 5%	± 1 km
3.5.2.17.10	*Refresh Rate/Coverage Time*	60 min	60 min
3.5.2.17.11	*Data Latency*	15 min	15 min

3.5.3 Performance Characteristics: Atmosphere / Precipitation

3.5.3.1 HAIL DETECTION: CONUS

3.5.3.1.1 Definition

Hail is precipitation in the form of balls or irregular lumps of ice, always produced by convective clouds, nearly always cumulonimbus. Hail detection is the estimate of the likelihood that hail is present in a storm.

3.5.3.1.2 P³I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.3.1.3	*User & Priority (LO-#)*	NESDIS/OSDPD-2	NESDIS/OSDPD-2
3.5.3.1.4	*Geographic Coverage*	CONUS	Hemispheric
3.5.3.1.5	*Vertical Resolution*	TBS	TBS
3.5.3.1.6	*Horizontal Resolution*	2 km	1 km
3.5.3.1.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.3.1.8	*Measurement Range*	TBS	TBS
3.5.3.1.9	*Measurement Accuracy*	TBS	TBS
3.5.3.1.10	*Refresh Rate/Coverage Time*	5 min	1 min
3.5.3.1.11	*Data Latency*	1 min	1 min

3.5.3.2 HAIL DETECTION: HEMISPHERIC

3.5.3.2.1 Definition

See requirement definition above.

3.5.3.2.2 P^3I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.3.2.3	*User & Priority (LO-#)*	NESDIS/ORA-3	NESDIS/ORA-3
3.5.3.2.4	*Geographic Coverage*	Hemispheric	Global
3.5.3.2.5	*Vertical Resolution*	TBS	TBS
3.5.3.2.6	*Horizontal Resolution*	10 km	1 km
3.5.3.2.7	*Mapping Accuracy*	TBS	TBS
3.5.3.2.8	*Measurement Range*	0 - 1	TBS
3.5.3.2.9	*Measurement Accuracy*	10%	TBS
3.5.3.2.10	*Refresh Rate/Coverage Time*	15 min	1min
3.5.3.2.11	*Data Latency*	TBS	TBS

3.5.3.3 HAIL DETECTION: MESOSCALE

3.5.3.3.1 Definition

See requirement definition above.

3.5.3.3.2 P^3I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.3.3.3	*User & Priority (LO-#)*	OAR/NSSL-2	OAR/NSSL-2
3.5.3.3.4	*Geographic Coverage*	Mesoscale	Mesoscale
3.5.3.3.5	*Vertical Resolution*	TBS	TBS
3.5.3.3.6	*Horizontal Resolution*	0.5 km	0.5 km
3.5.3.3.7	*Mapping Accuracy*	0.2 km	0.2 km
3.5.3.3.8	*Measurement Range*	0 - 1	0 - 1
3.5.3.3.9	*Measurement Accuracy*	10%	10%
3.5.3.3.10	*Refresh Rate/Coverage Time*	5 min	1 min
3.5.3.3.11	*Data Latency*	5 min	5 min

3.5.3.4 PRECIPITATION TYPE/RATE: CONUS

3.5.3.4.1 Definition

Precipitation type is a determination of when and where particular types of precipitation (rain, freezing rain, sleet, snow) will occur. Precipitation rate is the amount of water applied to a given area of landscape for a specified period of time; also known as the precipitation intensity.

3.5.3.4.2 P^3I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.3.4.3	*User & Priority (LO-#)*	NWS/NCEP/AWC-1 NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/WFO-2 NWS/NCEP/CPC – 2 OAR/AOML/HRD-1 DoD/USA-1	NWS/NCEP/AWC-1 NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/WFO-2 NWS/NCEP/CPC – 2 OAR/AOML/HRD-1 DoD/USA-1
3.5.3.4.4	*Geographic Coverage*	CONUS	CONUS
3.5.3.4.5	*Vertical Resolution*	TBS	TBS
3.5.3.4.6	*Horizontal Resolution*	10 km	2 km
3.5.3.4.7	*Mapping Accuracy*	5 km	1 km
3.5.3.4.8	*Measurement Range*	0 - 100 mm/hr	0 - 100 mm/hr
3.5.3.4.9	*Measurement Accuracy*	1 mm/hr	1 mm/hr
3.5.3.4.10	*Refresh Rate/Coverage Time*	30 min	15 min
3.5.3.4.11	*Data Latency*	3 min	1 min

3.5.3.5 PRECIPITATION TYPE/RATE: GLOBAL

3.5.3.5.1 Definition

See requirement definition above.

3.5.3.5.2 P³I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture

Attribute		Threshold	Objective
3.5.3.5.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/AWC-1 NWS/HPC-1 NWS/NCEP/OPC-1 OAR/AOML/HRD-1 NWS/NCEP/CPC – 2 NWS/WFO-2 DoD/USA-1 DoD/USN-USMC-1 Europeans - UA	Climate-1 NWS/NCEP/AWC-1 NWS/HPC-1 NWS/NCEP/OPC-1 OAR/AOML/HRD-1 NWS/NCEP/CPC – 2 NWS/WFO-2 DoD/USA-1 DoD/USN-USMC-1 Europeans - UA
3.5.3.5.4	*Geographic Coverage*	Global	Global
3.5.3.5.5	*Vertical Resolution*	TBS	TBS
3.5.3.5.6	*Horizontal Resolution*	0.5 km	0.5 km
3.5.3.5.7	*Mapping Accuracy*	5 km	1 km
3.5.3.5.8	*Measurement Range*	0 – 100 mm/hr	0 – 100 mm/hr
3.5.3.5.9	*Measurement Accuracy*	1 mm/hr	0.125 mm/hr
3.5.3.5.10	*Refresh Rate/Coverage Time*	5 min	5 min
3.5.3.5.11	*Data Latency*	15 min	1 min
3.5.3.5.12	*Long-term Stability*	TBS	0.003 mm/hr

3.5.3.6 PRECIPITATION TYPE/RATE: HEMISPHERIC

3.5.3.6.1 Definition

See requirement definition above.

3.5.3.6.2 P³I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.3.6.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/AWC-1 NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NWS/NCEP/CPC-2 Hydrology Program - UA DoD/USAF-1 DoD/USN-USMC-1 Europeans - UA	Climate-1 NWS/NCEP/AWC-1 NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NWS/NCEP/CPC-2 Hydrology Program - UA DoD/USAF-1 DoD/USN-USMC-1 Europeans - UA
3.5.3.6.4	*Geographic Coverage*	Hemispheric	Hemispheric
3.5.3.6.5	*Vertical Resolution*	TBS	TBS
3.5.3.6.6	*Horizontal Resolution*	0.5 km	0.5 km
3.5.3.6.7	*Mapping Accuracy*	5 km	1 km
3.5.3.6.8	*Measurement Range*	0 - 100 mm/hr	0 - 50mm / 15 minutes
3.5.3.6.9	*Measurement Accuracy*	1 mm/hr	0.125 mm/hr
3.5.3.6.10	*Refresh Rate/Coverage Time*	5 min	7.5 min
3.5.3.6.11	*Data Latency*	15 min	1 min
3.5.3.6.12	*Long-term Stability*	TBS	0.003 mm/hr

3.5.3.7 PRECIPITATION TYPE/RATE: MESOSCALE

3.5.3.7.1 Definition

See requirement definition above.

3.5.3.7.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.3.7.3	*User & Priority (LO-#)*	NWS/NCEP/AWC-1 NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/WFO-2 OAR/AOML/HRD-1 OAR/NSSL-1	NWS/NCEP/AWC-1 NWS/NCEP/HPC-1 NWS/NCEP/OPC-1 NWS/WFO-2 OAR/AOML/HRD-1 OAR/NSSL-1
3.5.3.7.4	*Geographic Coverage*	Mesoscale	Mesoscale
3.5.3.7.5	*Vertical Resolution*	TBS	TBS
3.5.3.7.6	*Horizontal Resolution*	10 km	0.5 km
3.5.3.7.7	*Mapping Accuracy*	5 km	0.2 km
3.5.3.7.8	*Measurement Range*	0 - 100 mm/hr	0 - 100 mm/hr
3.5.3.7.9	*Measurement Accuracy*	1 mm/hr	1 mm/hr
3.5.3.7.10	*Refresh Rate/Coverage Time*	60 min	1 min
3.5.3.7.11	*Data Latency*	15 min	1 min

3.5.4 Performance Characteristics: Atmosphere / Profiles

3.5.4.1 ATMOSPHERIC VERTICAL MOISTURE PROFILE: CONUS

3.5.4.1.1 Definition

Water vapor mixing ratio profile throughout the troposphere (Units: g kg^{-1}).

3.5.4.1.2 P³I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.1.3	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 DoD/USA-1	NWS/NCEP/OPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 DoD/USA-1
3.5.4.1.4	*Geographic Coverage*	CONUS – All Weather	Hemispheric – All Weather
3.5.4.1.5	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb:2 km 300-100 mb: 2 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km
3.5.4.1.6	*Horizontal Resolution*	10 km	1 km
3.5.4.1.7	*Mapping Accuracy*	2 km	0.2 km
3.5.4.1.8	*Measurement Range*	0 – 100%	0 – 100%
3.5.4.1.9	*Measurement Accuracy*	Sfc-500 mb: 10% 500-300 mb: 10% 300-100 mb: 20%	Sfc-500 mb: 1% 500-300 mb: 1% 300-100 mb: 5%
3.5.4.1.10	*Refresh Rate/Coverage Time*	60 min	5 min
3.5.4.1.11	*Data Latency*	15 min	1 min

3.5.4.2 ATMOSPHERIC VERTICAL MOISTURE PROFILE: GLOBAL

3.5.4.2.1 Definition

See requirement definition above.

3.5.4.2.2 P³I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.2.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 OAR/AOML/HRD-1 DoD/USA-1 DoD/USN-USMC-1 DoD/USAF-1 Europeans - UA	Climate-1 NWS/NCEP/OPC-1 OAR/AOML/HRD-1 DoD/USA-1 DoD/USN-USMC-1 DoD/USAF-1 Europeans - UA
3.5.4.2.4	*Geographic Coverage*	Global – All Weather	Global – All Weather
3.5.4.2.5	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb:2 km 300-100 mb: 2 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km
3.5.4.2.6	*Horizontal Resolution*	4 km	2 km
3.5.4.2.7	*Mapping Accuracy*	2 km	0.5 km
3.5.4.2.8	*Measurement Range*	0 – 100 %	0 – 100 %
3.5.4.2.9	*Measurement Accuracy*	Sfc-500 mb: 10% 500-300 mb: 10% 300-100 mb: 20%	Sfc-500 mb: 5% 500-300 mb: 5% 300-100 mb: 10%
3.5.4.2.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.2.11	*Data Latency*	15 min	1 min
3.5.4.2.12	*Long-term Stability*	TBS	0.26 %

3.5.4.3 ATMOSPHERIC VERTICAL MOISTURE PROFILE: HEMISPHERIC

3.5.4.3.1 Definition

See requirement definition above.

3.5.4.3.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.3.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 Hydrology Program - UA DoD/USN-USMC-1 DoD/USA-1	Climate-1 NWS/NCEP/OPC-1 NWS/WFO-1 OAR/AOML/HRD-1 NESDIS/OSDPD-2 Hydrology Program - UA DoD/USN-USMC-1 DoD/USA-1
3.5.4.3.4	*Geographic Coverage*	Hemispheric – All Weather	Hemispheric – All Weather
3.5.4.3.5	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb:2 km 300-100 mb: 2 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km
3.5.4.3.6	*Horizontal Resolution*	4 km	2 km
3.5.4.3.7	*Mapping Accuracy*	2 km	0.5 km
3.5.4.3.8	*Measurement Range*	0 - 100%	0 - 100%
3.5.4.3.9	*Measurement Accuracy*	Sfc-500 mb: 10% 500-300 mb: 10% 300-100 mb: 20%	Sfc-500 mb: 5% 500-300 mb: 5% 300-100 mb: 10%
3.5.4.3.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.3.11	*Data Latency*	3 min	1 min
3.5.4.3.12	*Long-term Stability*	TBS	0.2 K

3.5.4.4 ATMOSPHERIC VERTICAL MOISTURE PROFILE: MESOSCALE

3.5.4.4.1 Definition

See requirement definition above.

3.5.4.4.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.4.3	*User & Priority (LO-#)*	NWS/NCEP/OPC – 1 NWS/WFO - 1 OAR/AOML/HRD-1 OAR/NSSL-2 DoD/USA-1	NWS/NCEP/OPC – 1 NWS/WFO - 1 OAR/AOML/HRD-1 OAR/NSSL-2 DoD/USA-1
3.5.4.4.4	*Geographic Coverage*	Mesoscale – All Weather	Mesoscale – All Weather
3.5.4.4.5	*Vertical Resolution*	Surface - 100 mb: 2km	Sfc-500 mb: 300 500-300 mb: 1 km 300-100 mb: 1 km
3.5.4.4.6	*Horizontal Resolution*	4 km	2 km
3.5.4.4.7	*Mapping Accuracy*	2 km	0.5 km
3.5.4.4.8	*Measurement Range*	0 – 100%	0 – 100%
3.5.4.4.9	*Measurement Accuracy*	Sfc-500 mb: 10% 500-300 mb: 10% 300-100 mb: 20%	5 %
3.5.4.4.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.4.11	*Data Latency*	15 min	1 min

3.5.4.5 ATMOSPHERIC VERTICAL TEMPERATURE PROFILE: CONUS

3.5.4.5.1 Definition

Sampling of temperature at stated intervals throughout the atmosphere.

3.5.4.5.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.5.3	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NWS/WFO-1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 DoD/USA-1	NWS/NCEP/OPC-1 NWS/WFO-1 NESDIS/OSDPD-2 NESDIS/ORA-3 OAR/FSL-3 DoD/USA-1
3.5.4.5.4	*Geographic Coverage*	CONUS – All Weather	CONUS – All Weather
3.5.4.5.5	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb +: 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb +: 2 km
3.5.4.5.6	*Horizontal Resolution*	10 km	1 km
3.5.4.5.7	*Mapping Accuracy*	2 km	0.2 km
3.5.4.5.8	*Measurement Range*	210 - 320 K	180 - 325 K
3.5.4.5.9	*Measurement Accuracy*	±1 K/km	±0.5 K/km
3.5.4.5.10	*Refresh Rate/Coverage Time*	60 min	5 min
3.5.4.5.11	*Data Latency*	3 min	1 min

3.5.4.6 ATMOSPHERIC VERTICAL TEMPERATURE PROFILE: GLOBAL

3.5.4.6.1 Definition

See requirement definition above.

3.5.4.6.2 P^3I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.6.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1 Europeans - UA	Climate-1 NWS/NCEP/OPC-1 DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1 Europeans - UA
3.5.4.6.4	*Geographic Coverage*	Global – All Weather	Global – All Weather
3.5.4.6.5	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb+ : 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb+ : 2 km
3.5.4.6.6	*Horizontal Resolution*	10 km	2 km
3.5.4.6.7	*Mapping Accuracy*	5 km	0.5 km
3.5.4.6.8	*Measurement Range*	210 - 314 K	210 - 320 K
3.5.4.6.9	*Measurement Accuracy*	1 K	0.5 K
3.5.4.6.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.6.11	*Data Latency*	3 min	1 min
3.5.4.6.12	*Long-term Stability*	TBS	Troposphere: 0.04 K Stratosphere: 0.08 K

3.5.4.7 ATMOSPHERIC VERTICAL TEMPERATURE PROFILE: HEMISPHERIC

3.5.4.7.1 Definition

See requirement definition above.

3.5.4.7.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.7.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-1 NWS/WFO-1 NESDIS/OSDPD-2 Hydrology Program - UA DoD/USN-USMC-1 DoD/USA-1	Climate-1 NWS/NCEP/OPC-1 NWS/WFO-1 NESDIS/OSDPD-2 Hydrology Program - UA DoD/USN-USMC-1 DoD/USA-1
3.5.4.7.4	*Geographic Coverage*	Hemispheric – All Weather	Hemispheric – All Weather
3.5.4.7.5	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb +: 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb +: 2 km
3.5.4.7.6	*Horizontal Resolution*	10 km	2 km
3.5.4.7.7	*Mapping Accuracy*	2 km	0.5 km
3.5.4.7.8	*Measurement Range*	210 - 320 K	210 - 320 K
3.5.4.7.9	*Measurement Accuracy*	± 1 K/km	± 0.5 K/km
3.5.4.7.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.7.11	*Data Latency*	3 min	1 min
3.5.4.7.12	*Long-term Stability*	TBS	Troposphere: 0.04 K Stratosphere: 0.08 K

3.5.4.8 ATMOSPHERIC VERTICAL TEMPERATURE PROFILE: MESOSCALE

3.5.4.8.1 Definition

See requirement definition above.

3.5.4.8.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.8.3	*User & Priority (LO-#)*	NWS/NCEP/OPC-1 NWS/WFO-1 OAR/NSSL-2 DoD/USA-1	NWS/NCEP/OPC-1 NWS/WFO-1 OAR/NSSL-2 DoD/USA-1
3.5.4.8.4	*Geographic Coverage*	Mesoscale – All Weather	Mesoscale – All Weather
3.5.4.8.5	*Vertical Resolution*	Sfc-500 mb: 500 m 500-300 mb: 2 km 300-100 mb: 2 km 100 mb +: 3 km	Sfc-500 mb: 300 m 500-300 mb: 1 km 300-100 mb: 1 km 100 mb +: 2 km
3.5.4.8.6	*Horizontal Resolution*	10 km	2 km
3.5.4.8.7	*Mapping Accuracy*	2 km	0.5 km
3.5.4.8.8	*Measurement Range*	210 - 320 K	190 - 320 K
3.5.4.8.9	*Measurement Accuracy*	±1 K/km	±0.5 K/km
3.5.4.8.10	*Refresh Rate/Coverage Time*	60 min	5 min
3.5.4.8.11	*Data Latency*	15 min	1 min

3.5.4.9 CAPPING INVERSION INFORMATION: CONUS

3.5.4.9.1 Definition

A layer of relatively warm air aloft (usually several thousand feet above the ground) which suppresses or delays the development of thunderstorms

A statically stable layer at the top of the atmospheric boundary layer.

Although the word inversion implies that temperature increases with height, the word capping inversion is used more loosely for any stable layer (potential temperature increasing with height) at the top of the boundary layer. This inversion is a ubiquitous feature of the atmospheric boundary layer, formed because the troposphere is statically stable on the average, and because turbulence homogenizes air within the boundary layer, which by conservation of heat requires that a stable layer form at the top of the boundary layer. This inversion traps surface-induced turbulence and air pollutants below it, and causes the free atmosphere to not feel the earth's surface during fair weather (i.e., no drag, free slip, no heat or moisture from the surface, and winds are nearly geostrophic) [*Glossary of Meteorology*].

3.5.4.9.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.9.3	*User & Priority (LO-#)*	NWS/NCEP/AWC-1 NESDIS/OSDPD-2	NWS/NCEP/AWC-1 NESDIS/OSDPD-2
3.5.4.9.4	*Geographic Coverage*	CONUS – All Weather	CONUS – All Weather
3.5.4.9.5	*Vertical Resolution*	Sfc-500 mb: 500 m	Sfc-500 mb: 300 m
3.5.4.9.6	*Horizontal Resolution*	10 km	2 km
3.5.4.9.7	*Mapping Accuracy*	2 km	0.5 km
3.5.4.9.8	*Measurement Range*	T: 210-300 K Td: 210-300 K Hgt: Sfc-650 mb	T: 210-300 K Td: 210-300 K Hgt: Sfc-650 mb
3.5.4.9.9	*Measurement Accuracy*	T: 10 K Td: 10 K Hgt: 150-250 mb	T: 10 K Td: 10 K Hgt:150-250 mb
3.5.4.9.10	*Refresh Rate/Coverage Time*	15 min	5 min
3.5.4.9.11	*Data Latency*	3 min	1 min

3.5.4.10 CAPPING INVERSION INFORMATION: MESOSCALE

3.5.4.10.1 Definition

See requirement definition above.

3.5.4.10.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.10.3	*User & Priority (LO-#)*	OAR/NSSL-1	OAR/NSSL-1
3.5.4.10.4	*Geographic Coverage*	Mesoscale – All Weather	Mesoscale – All Weather
3.5.4.10.5	*Vertical Resolution*	Surface - 500 mb	Surface - 500 mb
3.5.4.10.6	*Horizontal Resolution*	2 km	2 km
3.5.4.10.7	*Mapping Accuracy*	0.5 km	0.5 km
3.5.4.10.8	*Measurement Range*	0 - 20 K (delta T & Td)	0 - 20 K (delta T & Td)
3.5.4.10.9	*Measurement Accuracy*	0.5 K	0.5 K
3.5.4.10.10	*Refresh Rate/Coverage Time*	15 min	5 min
3.5.4.10.11	*Data Latency*	15 min	15 min

3.5.4.11 MOISTURE FLUX: CONUS

3.5.4.11.1 Definition

Refers to net surface flux over oceans (including ice covered). The components of heat flux are longwave/shortwave radiation, latent heat flux, and sensible heat flux.

Heat Flux. A quantity measured according to the formula $B=\lambda\ dT/dz$, where λ is the thermal conductivity of the medium (i.e., soil, air) that the moisture (or heat) is moving through. This may be expressed as flux per unit area for heat or moisture. [*Glossary of Meteorology*]

3.5.4.11.2 P³I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.11.3	*User & Priority (LO-#)*	NWS/NCEP/AWC-1 NWS/NCEP/OPC-1 NWS/WFO-1 NESDIS/OSDPD-2	NWS/NCEP/AWC-1 NWS/NCEP/OPC-1 NWS/WFO-1 NESDIS/OSDPD-2
3.5.4.11.4	*Geographic Coverage*	CONUS – All Weather	Hemispheric – All Weather
3.5.4.11.5	*Vertical Resolution*	3 km	1 km
3.5.4.11.6	*Horizontal Resolution*	4 km	2 km
3.5.4.11.7	*Mapping Accuracy*	1 km	0.5 km
3.5.4.11.8	*Measurement Range*	0 – 20 g/kg/h	0 – 20 g/kg/h
3.5.4.11.9	*Measurement Accuracy*	10%	5%
3.5.4.11.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.11.11	*Data Latency*	3 min	1 min

3.5.4.12 MOISTURE FLUX: GLOBAL

3.5.4.12.1 Definition

See requirement definition above.

3.5.4.12.2 P³I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.12.3	*User & Priority (LO-#)*	NWS/NCEP/OPC - 3	NWS/NCEP/OPC - 3
3.5.4.12.4	*Geographic Coverage*	Global – All Weather	Global – All Weather
3.5.4.12.5	*Vertical Resolution*	3 km	1 km
3.5.4.12.6	*Horizontal Resolution*	4 km	2 km
3.5.4.12.7	*Mapping Accuracy*	1 km	0.5 km
3.5.4.12.8	*Measurement Range*	0 – 20 g/kg/h	0 – 20 g/kg/h
3.5.4.12.9	*Measurement Accuracy*	10%	5%
3.5.4.12.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.12.11	*Data Latency*	3 min	1 min

3.5.4.13 MOISTURE FLUX: HEMISPHERIC

3.5.4.13.1 Definition

See requirement definition above.

3.5.4.13.2 P^{3}I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.13.3	*User & Priority (LO-#)*	NWS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3	NWS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3
3.5.4.13.4	*Geographic Coverage*	Hemispheric – All Weather	Hemispheric – All Weather
3.5.4.13.5	*Vertical Resolution*	3 km	1 km
3.5.4.13.6	*Horizontal Resolution*	4 km	2 km
3.5.4.13.7	*Mapping Accuracy*	1 km	0.5 km
3.5.4.13.8	*Measurement Range*	0 – 20 g/kg/h	0 – 20 g/kg/h
3.5.4.13.9	*Measurement Accuracy*	10%	5%
3.5.4.13.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.13.11	*Data Latency*	3 min	1 min

3.5.4.14 MOISTURE FLUX: MESOSCALE

3.5.4.14.1 Definition

See requirement definition above.

3.5.4.14.2 P^{3}I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.14.3	*User & Priority (LO-#)*	NWS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3 OAR/NSSL-2	NWS/NCEP/EMC-1 NWS/WFO-2 NWS/NCEP/OPC-3
3.5.4.14.4	*Geographic Coverage*	Mesoscale – All Weather	Mesoscale – All Weather
3.5.4.14.5	*Vertical Resolution*	3 km	1 km
3.5.4.14.6	*Horizontal Resolution*	4 km	2 km
3.5.4.14.7	*Mapping Accuracy*	1 km	0.5 km
3.5.4.14.8	*Measurement Range*	0 – 20 g/kg/h	0 – 20 g/kg/h
3.5.4.14.9	*Measurement Accuracy*	10%	5%
3.5.4.14.10	*Refresh Rate/Coverage Time*	60 min	5 min
3.5.4.14.11	*Data Latency*	15 min	1 min

3.5.4.15 PRESSURE PROFILE: GLOBAL

3.5.4.15.1 Definition

Vertical profile of the pressure exerted by the atmosphere as a consequence of gravitational attraction exerted upon the "column" of air lying directly above the point in question [*Glossary of Meteorology*].

3.5.4.15.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.15.3	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.5.4.15.4	*Geographic Coverage*	Global	Global
3.5.4.15.5	*Vertical Resolution*	TBS	0.25 km
3.5.4.15.6	*Horizontal Resolution*	TBS	5 km
3.5.4.15.7	*Mapping Accuracy*	TBS	1 km
3.5.4.15.8	*Measurement Range*	TBS	0 - 1050 mb
3.5.4.15.9	*Measurement Accuracy*	TBS	0.50 %
3.5.4.15.10	*Refresh Rate/Coverage Time*	TBS	60 min
3.5.4.15.11	*Data Latency*	TBS	15 min

3.5.4.16 TOTAL PRECIPITABLE WATER: GLOBAL

3.5.4.16.1 Definition

The total atmospheric water vapor contained in a vertical column of unit cross-sectional area extending between any two specified levels, commonly expressed in terms of the height to which that water substance would stand if completely condensed and collected in a vessel of the same unit cross section [*Glossary of Weather and Climate*].

3.5.4.16.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.16.3	*User & Priority (LO-#)*	Climate-1 DoD/USAF-1 Europeans - UA	Climate-1 DoD/USAF-1 Europeans - UA
3.5.4.16.4	*Geographic Coverage*	Global	Global
3.5.4.16.5	*Vertical Resolution*	TBS	TBS
3.5.4.16.6	*Horizontal Resolution*	100 km	25 km
3.5.4.16.7	*Mapping Accuracy*	TBS	TBS
3.5.4.16.8	*Measurement Range*	TBS	TBS
3.5.4.16.9	*Measurement Accuracy*	TBS	TBS
3.5.4.16.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.16.11	*Data Latency*	TBS	TBS
3.5.4.16.12	*Long-term Stability*	TBS	TBS

3.5.4.17 TOTAL WATER CONTENT: GLOBAL

3.5.4.17.1 Definition

Measure of moisture in a given volume of the atmosphere. The requirements below apply under both clear and cloudy conditions. Total water content is defined as the water vapor, liquid water, and cloud ice liquid equivalent in specified segments of a vertical column of the atmosphere.

3.5.4.17.2 P³I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.17.3	*User & Priority (LO-#)*	Climate-1 NWS/NCEP/OPC-2 DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1 Europeans - UA	Climate-1 NWS/NCEP/OPC-2 DoD/USN-USMC-1 DoD/USA-1 DoD/USAF-1 Europeans - UA
3.5.4.17.4	*Geographic Coverage*	Global – All Weather	Global – All Weather
3.5.4.17.5	*Vertical Resolution*	Surface – Top of Atmosphere	Surface – Top of Atmosphere
3.5.4.17.6	*Horizontal Resolution*	0.5 km	0.2 km
3.5.4.17.7	*Mapping Accuracy*	0.5 km	0.2 km
3.5.4.17.8	*Measurement Range*	0 – 100 mm	0 – 100 mm
3.5.4.17.9	*Measurement Accuracy*	1 mm	1 mm
3.5.4.17.10	*Refresh Rate/Coverage Time*	15 min	15 min
3.5.4.17.11	*Data Latency*	1 min	1 min
3.5.4.17.12	*Long-term Stability*	TBS	TBS

3.5.4.18 TOTAL WATER CONTENT: HEMISPHERIC

3.5.4.18.1 Definition

See requirement definition above.

3.5.4.18.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.18.3	*User & Priority (LO-#)*	NWS/NCEP/AWC-1 NESDIS/OSDPD-1 OAR/AOML/HRD-1 DoD/USN-USMC-1 NWS/NCEP/OPC-2	NWS/NCEP/AWC-1 NESDIS/OSDPD-1 OAR/AOML/HRD-1 DoD/USN-USMC-1 NWS/NCEP/OPC-2
3.5.4.18.4	*Geographic Coverage*	Hemispheric – All Weather	Hemispheric – All Weather
3.5.4.18.5	*Vertical Resolution*	Surface - TOA	Surface - TOA
3.5.4.18.6	*Horizontal Resolution*	2 km	0.5 km
3.5.4.18.7	*Mapping Accuracy*	1 km	0.2 km
3.5.4.18.8	*Measurement Range*	0 - 100 mm	0 - 100 mm
3.5.4.18.9	*Measurement Accuracy*	1 mm	1 mm
3.5.4.18.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.18.11	*Data Latency*	15 min	1 min

3.5.4.19 TOTAL WATER CONTENT: MESOSCALE

3.5.4.19.1 Definition

See requirement definition above.

3.5.4.19.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.19.3	*User & Priority (LO-#)*	OAR/NSSL-1 OAR/AOML/HRD-1 DoD/USA-1	OAR/NSSL-1 OAR/AOML/HRD-1 DoD/USA-1
3.5.4.19.4	*Geographic Coverage*	Mesoscale – All Weather	Mesoscale – All Weather
3.5.4.19.5	*Vertical Resolution*	Surface - TOA	Surface - TOA
3.5.4.19.6	*Horizontal Resolution*	2 km	0.5 km
3.5.4.19.7	*Mapping Accuracy*	1 km	0.2 km
3.5.4.19.8	*Measurement Range*	0 – 100 mm	0 – 100 mm
3.5.4.19.9	*Measurement Accuracy*	1 mm	1 mm
3.5.4.19.10	*Refresh Rate/Coverage Time*	60 min	1 min
3.5.4.19.11	*Data Latency*	15 min	5 min

3.5.4.20 TROPICAL CYCLONE INNER CORE TEMPERATURE STRUCTURE

3.5.4.20.1 Definition

Atmospheric temperature soundings/structure in and around the Tropical Cyclone inner core. This parameter is used to determine the intensity of tropical cyclones.

3.5.4.20.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.4.20.3	*User & Priority (LO-#)*	NWS/NCEP/TPC-1	NWS/NCEP/TPC-1
3.5.4.20.4	*Geographic Coverage*	Mesoscale	Hemispheric
3.5.4.20.5	*Vertical Resolution*	Surface - 100 mb +	TBS
3.5.4.20.6	*Horizontal Resolution*	10 km	2 km
3.5.4.20.7	*Mapping Accuracy*	2 km	0.5 km
3.5.4.20.8	*Measurement Range*	210 - 300 K	TBS
3.5.4.20.9	*Measurement Accuracy*	±1 K/km	±0.5 K/km
3.5.4.20.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.4.20.11	*Data Latency*	3 min	1 min

3.5.5 Performance Characteristics: Atmosphere / Radiances

3.5.5.1 RADIANCES: GLOBAL

3.5.5.1.1 Definition

Total energy radiated by an object of unit area per solid angle of measurement. Standard measurement unit W/m^2.

The observed radiance of the top of the atmosphere in the Thermal Infra Red (TIR), microwave (MW) and visible (VIS) bands. Radiance obtained along a spectral band on a specific target is converted into brightness temperature using tables derived from Planck's formula.

Attribute		Threshold	Objective
3.5.5.1.2	*User & Priority (LO-#)*	Climate-1	Climate-1
3.5.5.1.3	*Geographic Coverage*	Global	Global
3.5.5.1.4	*Vertical Resolution*	1 - 2.5 cm^{-1}	0.6 - 1 cm^{-1}
3.5.5.1.5	*Horizontal Resolution*	100 km	4 km
3.5.5.1.6	*Mapping Accuracy*	2.5 km	1 km
3.5.5.1.7	*Measurement Range*	180 - 330 K (VIS, IR & MW)	180 - 330 K (VIS, IR & MW)
3.5.5.1.8	*Measurement Accuracy*	TBS	0.1 K
3.5.5.1.9	*Refresh Rate*	60 min	15 min
3.5.5.1.10	*Data Latency*	60 min	15 min
3.5.5.1.11	*Long-term Stability*	TBS	0.04 K

3.5.5.2 RADIANCES: MESOSCALE

3.5.5.2.1 Definition

See requirement definition above.

Attribute		Threshold	Objective
3.5.5.2.2	*User & Priority (LO-#)*	NWS/NCEP/EMC-1 NESDIS/ORA-3	NWS/NCEP/EMC-1 NESDIS/ORA-3
3.5.5.2.3	*Geographic Coverage*	Mesoscale	Mesoscale
3.5.5.2.4	*Vertical Resolution*	1 - 2.5 cm^{-1}	0.6 - 1 cm^{-1}
3.5.5.2.5	*Horizontal Resolution*	0.5 km	0.5 km
3.5.5.2.6	*Mapping Accuracy*	0.2 km	0.2 km
3.5.5.2.7	*Measurement Range*	180 - 330 K (VIS, IR & MW)	180 - 330 K (VIS, IR & MW)
3.5.5.2.8	*Measurement Accuracy*	TBS	TBS
3.5.5.2.9	*Refresh Rate*	60 min	10 min
3.5.5.2.10	*Data Latency*	30 min	5 min

3.5.6 Performance Characteristics: Atmosphere / Radiation

3.5.6.1 ABSORBED SHORTWAVE RADIATION: SURFACE / GLOBAL

3.5.6.1.1 Definition

Incoming shortwave radiation is radiation received from the Sun at wavelengths shorter than 4 μm. Sometimes called the solar radiation. Usually radiation in the visible and near-infrared wavelengths. Incoming solar radiation that strikes the earth's surface and is absorbed by the earth's surface [*WMO, 1966*].

3.5.6.1.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.6.1.3	*User & Priority (LO-#)*	NOS/ORR-1	NOS/ORR-1
3.5.6.1.4	*Geographic Coverage*	Global / Tropics	Global / Tropics
3.5.6.1.5	*Horizontal Resolution*	50 km	10 km
3.5.6.1.6	*Mapping Accuracy*	< 5 km	< 1 km
3.5.6.1.7	*Measurement Range*	0 – 700 W/m^2	0 – 700 W/m^2
3.5.6.1.8	*Measurement Accuracy*	7 W/m^2	5 W/m^2
3.5.6.1.9	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.6.1.10	*Data Latency*	60 min	5 min

3.5.6.2 ABSORBED SHORTWAVE RADIATION: SURFACE / HEMISPHERIC

3.5.6.2.1 Definition

See requirement definition above.

3.5.6.2.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.6.2.3	*User & Priority (LO-#)*	NOS/ORR-1	NOS/ORR-1
3.5.6.2.4	*Geographic Coverage*	Hemispheric / Tropics	Hemispheric / Tropics
3.5.6.2.5	*Horizontal Resolution*	50 km	10 km
3.5.6.2.6	*Mapping Accuracy*	< 5 km	< 1 km
3.5.6.2.7	*Measurement Range*	0 – 700 W/m^2	0 – 700 W/m^2
3.5.6.2.8	*Measurement Accuracy*	7 W/m^2	5 W/m^2
3.5.6.2.9	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.6.2.10	*Data Latency*	60 min	5 min

3.5.6.3 DOWNWARD LONGWAVE RADIATION: SURFACE / GLOBAL

3.5.6.3.1 Definition

Longwave radiation is radiation with wavelengths longer than 4 μm. Also referred to as infrared radiation or terrestrial radiation.

The downward component of longwave radiation across a given surface, usually taken as the earth's surface. It is also known as counter radiation Counter radiation originates in emission by clouds and greenhouse gases at different heights and temperatures, and is modified by subsequent absorption before reaching the surface. [*Glossary of Meteorology*]

3.5.6.3.2 P^{3}I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.6.3.3	*User & Priority (LO-#)*	Climate-1	Climate-1
3.5.6.3.4	*Geographic Coverage*	Global	Global
3.5.6.3.5	*Horizontal Resolution*	100 km	25 km
3.5.6.3.6	*Mapping Accuracy*	TBS	TBS
3.5.6.3.7	*Measurement Range*	TBS	TBS
3.5.6.3.8	*Measurement Accuracy*	TBS	1 W/m^2
3.5.6.3.9	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.6.3.10	*Data Latency*	TBS	TBS
3.5.6.3.11	*Long-term Stability*	TBS	0.2 W/m^2

3.5.6.4 DOWNWARD SOLAR INSOLATION: SURFACE / GLOBAL

3.5.6.4.1 Definition

"Solar" refers to electromagnetic radiation in the spectral range of approximately 0.30 μm to 3.0 μm. Solar radiation is also often referred to as shortwave with the shortest wavelengths of solar known as UV, the middle wavelengths are in the visible part of the spectrum, and the wavelengths longer than visible are know as the near or solar infrared (IR).

The total solar radiation received at the earth's surface. Also know as the total downward solar irradiance. It is the total amount of solar irradiance on an upward-facing horizontal surface and is the sum of the vertical component of the direct solar irradiance and the diffuse sky irradiance. This is the fundamental quantity from which the world's weather/climate system obtains it energy. [*Measured Radiation Quantities*]

3.5.6.4.2 P^{3}I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.6.4.3	*User & Priority (LO-#)*	Climate-1 NOS/ORR-1	Climate-1 NOS/ORR-1
3.5.6.4.4	*Geographic Coverage*	Global / Tropics	Global / Tropics
3.5.6.4.5	*Horizontal Resolution*	50 km	10 km
3.5.6.4.6	*Mapping Accuracy*	TBS	TBS
3.5.6.4.7	*Measurement Range*	TBS	TBS
3.5.6.4.8	*Measurement Accuracy*	TBS	1 W/m^2
3.5.6.4.9	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.6.4.10	*Data Latency*	60 min	5 min
3.5.6.4.11	*Long-term Stability*	TBS	0.3 W/m^2

3.5.6.5 REFLECTED SOLAR INSOLATION: TOA / GLOBAL

3.5.6.5.1 Definition

"Solar" refers to electromagnetic radiation in the spectral range of approximately 0.30 μm to 3.0 μm. Solar radiation is also often referred to as shortwave with the shortest wavelengths of solar known as UV, the middle wavelengths are in the visible part of the spectrum, and the wavelengths longer than visible are know as the near or solar infrared (IR).

Reflected Solar Insolation (TOA) is the quantity is the solar irradiance incident upon a downward-facing surface, i.e., the top of the atmosphere. The source of the quantity is the downward solar irradiance that is reflected off the earth's surface. [*Measured Radiation Quantities*]

3.5.6.5.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.6.5.3	*User & Priority (LO-#)*	Climate-1 Europeans - UA	Climate-1 Europeans - UA
3.5.6.5.4	*Geographic Coverage*	Global	Global
3.5.6.5.5	*Vertical Resolution*	TBS	TBS
3.5.6.5.6	*Horizontal Resolution*	100 km	25 km
3.5.6.5.7	*Mapping Accuracy*	TBS	TBS
3.5.6.5.8	*Measurement Range*	TBS	TBS
3.5.6.5.9	*Measurement Accuracy*	TBS	1 W/m^2
3.5.6.5.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.6.5.11	*Data Latency*	TBS	TBS
3.5.6.5.12	*Long-term Stability*	TBS	0.3 W/m^2

3.5.6.6 UPWARD LONGWAVE RADIATION: SURFACE / GLOBAL

3.5.6.6.1 Definition

The outgoing longwave radiation (OLR) at the earth's surface refers specifically to the radiation emitted by the earth and its atmosphere (the terrestrial radiation) [*WMO, 1966*].

3.5.6.6.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.6.6.3	*User & Priority (LO-#)*	Climate-1	Climate-1
3.5.6.6.4	*Geographic Coverage*	Global	Global
3.5.6.6.5	*Vertical Resolution*	TBS	TBS
3.5.6.6.6	*Horizontal Resolution*	100 km	25 km
3.5.6.6.7	*Mapping Accuracy*	TBS	TBS
3.5.6.6.8	*Measurement Range*	TBS	TBS
3.5.6.6.9	*Measurement Accuracy*	TBS	1 W/m^2
3.5.6.6.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.6.6.11	*Data Latency*	TBS	TBS
3.5.6.6.12	*Long-term Stability*	TBS	0.2 W/m^2

3.5.6.7 UPWARD LONGWAVE RADIATION: TOA / GLOBAL

3.5.6.7.1 Definition

See requirement definition above.

3.5.6.7.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.6.7.3	*User & Priority (LO-#)*	Climate-1 Europeans - UA	Climate-1 Europeans - UA
3.5.6.7.4	*Geographic Coverage*	Global	Global
3.5.6.7.5	*Vertical Resolution*	TBS	TBS
3.5.6.7.6	*Horizontal Resolution*	100 km	25 km
3.5.6.7.7	*Mapping Accuracy*	TBS	TBS
3.5.6.7.8	*Measurement Range*	TBS	TBS
3.5.6.7.9	*Measurement Accuracy*	TBS	1 W/m^2
3.5.6.7.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.6.7.11	*Data Latency*	TBS	TBS
3.5.6.7.12	*Long-term Stability*	TBS	0.2 W/m^2

3.5.7 Performance Characteristics: Atmosphere / Trace Gases

3.5.7.1 CH_4 CONCENTRATION

3.5.7.1.1 Definition

Concentration of Methane (CH_4) gas. CH_4 is a colorless, odorless, flammable, greenhouse gas. It is released naturally into the air from marshes, swamps, rice fields, ruminant animals (such as cattle), and sewage sludge. CH_4 is also released from methane-producing bacteria (methanogens) that live in anaerobic places. [Solar Energy, v52n6; 467-477, 1994] [Air, The Nature of Atmosphere and the Climate, Michael Allaby, pages 39, 40, 1992, Facts on File; New York] [Dictionary of Science, R.K. Barnhart, page 398, 1986, Houghton Mifflin Company, Boston.] [*Atmospheric and Air Chemistry Glossary*]

Attribute		Threshold	Objective
3.5.7.1.2	*User & Priority (LO-#)*	NESDIS/ORA-3	NESDIS/ORA-3
3.5.7.1.3	*Geographic Coverage*	Hemispheric	Hemispheric
3.5.7.1.4	*Vertical Resolution*	TBS	Total
3.5.7.1.5	*Horizontal Resolution*	TBS	50 km
3.5.7.1.6	*Mapping Accuracy*	TBS	TBS
3.5.7.1.7	*Measurement Range*	TBS	TBS
3.5.7.1.8	*Measurement Accuracy*	TBS	±5%
3.5.7.1.9	*Refresh Rate*	TBS	60 min
3.5.7.1.10	*Data Latency*	TBS	TBS

3.5.7.2 CO_2 CONCENTRATION

3.5.7.2.1 Definition

Concentration of Carbon Dioxide (CO_2). CO_2 is one of the major greenhouse gases. Human-generated carbon dioxide is caused mainly by the burning of fossil fuels and deforestation. [*Atmospheric and Air Chemistry Glossary*]

Attribute		Threshold	Objective
3.5.7.2.2	*User & Priority (LO-#)*	Climate-2 NESDIS/ORA-3	Climate-2 NESDIS/ORA-3
3.5.7.2.3	*Geographic Coverage*	Global	Global
3.5.7.2.4	*Vertical Resolution*	TBS	Total
3.5.7.2.5	*Horizontal Resolution*	100 km	25 km
3.5.7.2.6	*Mapping Accuracy*	TBS	TBS
3.5.7.2.7	*Measurement Range*	TBS	TBS
3.5.7.2.8	*Measurement Accuracy*	TBS	10 ppmv
3.5.7.2.9	*Refresh Rate*	60 min	15 min
3.5.7.2.10	*Data Latency*	TBS	TBS
3.5.7.2.11	*Long-term Stability*	TBS	1 ppmv

3.5.7.3 OZONE LAYERS: CONUS

3.5.7.3.1 Definition

Ozone is a minor but important constituent (chemical symbol O_3) of the earth's atmosphere. While it is essential for life as we know it today, it is also a toxic gas that can result in significant physiological and ecological damage if exposures exceed critical limits. In both the stratosphere and troposphere, ozone concentration levels depend on many linked chemical and meteorological mechanisms, which vary significantly with space and time. This parameter is the number of distinct ozone layers, surface to top of stratosphere (about 48 km) [*Glossary of Meteorology*].

Attribute		Threshold	Objective
3.5.7.3.2	*User & Priority (LO-#)*	OAR/FSL-3	OAR/FSL-3
3.5.7.3.3	*Geographic Coverage*	CONUS	Hemispheric
3.5.7.3.4	*Vertical Resolution*	TBS	TBS
3.5.7.3.5	*Horizontal Resolution*	10 km	5 km
3.5.7.3.6	*Mapping Accuracy*	1 km	500 m
3.5.7.3.7	*Measurement Range*	TBS	TBS
3.5.7.3.8	*Measurement Accuracy*	TBS	TBS
3.5.7.3.9	*Refresh Rate*	30 min	10 min
3.5.7.3.10	*Data Latency*	10 min	1 min

3.5.7.4 OZONE LAYERS: GLOBAL

3.5.7.4.1 Definition

See requirement definition above.

3.5.7.4.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.7.4.3	*User & Priority (LO-#)*	Europeans - UA	Europeans - UA
3.5.7.4.4	*Geographic Coverage*	Global	Global
3.5.7.4.5	*Vertical Resolution*	10 km	1 km
3.5.7.4.6	*Horizontal Resolution*	250 km	15 km
3.5.7.4.7	*Mapping Accuracy*	TBS	TBS
3.5.7.4.8	*Measurement Range*	TBS	TBS
3.5.7.4.9	*Measurement Accuracy*	20%	5%
3.5.7.4.10	*Refresh Rate/Coverage Time*	12 hr	60 min
3.5.7.4.11	*Data Latency*	4 hr	60 min

3.5.7.5 OZONE TOTAL: GLOBAL

3.5.7.5.1 Definition

Measurement of ozone concentration within a specified volume. The ozone layer in the stratosphere absorbs UV radiation and creates a warm layer of air high in the stratosphere. Ozone that is present in the troposphere is mostly a result of anthropogenic pollution and therefore higher concentrations are found in urban areas. Ozone is involved with NOx in the photochemical production of many of the constituents of pollution environments (see nitrogen oxides and hydroxyl definitions) [Chemical and Engineering News, v72, 6-7, 1994.] [Aviation Week and Space Technology, v140, 20-21, 1994.] [*Atmospheric and Air Chemistry Glossary*].

3.5.7.5.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.7.5.3	*User & Priority (LO-#)*	Europeans - UA	Europeans - UA
3.5.7.5.4	*Geographic Coverage*	Global	Global
3.5.7.5.5	*Vertical Resolution*	TBS	TBS
3.5.7.5.6	*Horizontal Resolution*	250 km	15 km
3.5.7.5.7	*Mapping Accuracy*	TBS	TBS
3.5.7.5.8	*Measurement Range*	TBS	TBS
3.5.7.5.9	*Measurement Accuracy*	20 DU	5 DU
3.5.7.5.10	*Refresh Rate/Coverage Time*	12 hr	60 min
3.5.7.5.11	*Data Latency*	4 hr	60 min

3.5.8 Performance Characteristics: Atmosphere / Winds

3.5.8.1 DERIVED MOTION WINDS: GLOBAL

3.5.8.1.1 Definition

Produced by tracking features in the satellite water vapor channel and clouds in the IR window channel data. These are designated as 'water vapor' and 'cloud drift' winds. The latter are also called 'infrared' winds [*GOES Products and Services Catalog*].

3.5.8.1.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.8.1.3	*User & Priority (LO-#)*	Climate-2 DoD/USAF - 1 DoD/USN-USMC-1 Europeans-UA	Climate-2 DoD/USAF - 1 DoD/USN-USMC-1 Europeans-UA
3.5.8.1.4	*Geographic Coverage*	Global	Global
3.5.8.1.5	*Vertical Resolution*	TBS	TBS
3.5.8.1.6	*Horizontal Resolution*	100 km	25 km
3.5.8.1.7	*Mapping Accuracy*	TBS	TBS
3.5.8.1.8	*Measurement Range*	TBS	TBS
3.5.8.1.9	*Measurement Accuracy*	TBS	TBS
3.5.8.1.10	*Refresh Rate/Coverage Time*	60 min	15 min
3.5.8.1.11	*Data Latency*	TBS	TBS
3.5.8.1.12	*Long-term Stability*	TBS	TBS

3.5.9 Performance Characteristics: Land

3.5.9.1 FLOOD / STANDING WATER: GLOBAL

3.5.9.1.1 Definition

Accumulation of water over areas that are not normally submerged. A flooded area is an area covered by water when stream flow exceeds the carrying capacity of a channel or as a consequence of damming a river downstream [*UNESCO/WMO*].

3.5.9.1.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.1.3	*User & Priority (LO-#)*	DoD/USN&USMC-2	DoD/USN&USMC-2
3.5.9.1.4	*Geographic Coverage*	Global	Global
3.5.9.1.5	*Sensing Depth / Vertical Resolution*	5 cm	2 cm
3.5.9.1.6	*Horizontal Resolution*	10 km	1 km
3.5.9.1.7	*Mapping Accuracy*	1 km	0.5 km
3.5.9.1.8	*Measurement Range*	0 to 100%	0 to 100%
3.5.9.1.9	*Refresh Rate*	60 min	TBS
3.5.9.1.10	*Data Latency*	6 hr	TBS
3.5.9.1.11	*Long-term Stability*	TBS	TBS

3.5.9.2 ICE COVER / LANDLOCKED: GLOBAL

3.5.9.2.1 Definition

Extent of ice (i.e. glaciers, permafrost and ice sheets) over land, frozen inland lakes, and rivers [*Environmental Vulnerability Index*].

3.5.9.2.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.2.3	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.5.9.2.4	*Geographic Coverage*	Global	Global
3.5.9.2.5	*Horizontal Resolution*	TBS	10 km
3.5.9.2.6	*Mapping Accuracy*	TBS	5 km
3.5.9.2.7	*Measurement Range*	TBS	TBS
3.5.9.2.8	*Measurement Accuracy*	TBS	TBS
3.5.9.2.9	*Refresh Rate*	TBS	180 min
3.5.9.2.10	*Data Latency*	TBS	60 min
3.5.9.2.11	*Long-term Stability*	TBS	TBS

3.5.9.3 LAND SURFACE (SKIN) TEMPERATURE: GLOBAL

3.5.9.3.1 Definition

Land surface temperature is defined as the skin temperature of the uppermost layer of the land surface. It is the surface temperature at which the outgoing radiative flux at the surface balances the incoming radiative flux. It has two major applications: 1) characterization of backgrounds for electro-optical systems; and 2) use in infrared cloud/no cloud decision for processed cloud data.

3.5.9.3.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.3.3	*User & Priority (LO-#)*	Climate-2 DoD/USAF-1 DoD/USN&USMC-1 Europeans - UA	Climate-2 DoD/USAF-1 DoD/USN&USMC-1 Europeans - UA
3.5.9.3.4	*Geographic Coverage*	Global	Global
3.5.9.3.5	*Horizontal Resolution*	100 km	25 km
3.5.9.3.6	*Mapping Accuracy*	TBS	TBS
3.5.9.3.7	*Measurement Range*	TBS	TBS
3.5.9.3.8	*Measurement Accuracy*	TBS	TBS
3.5.9.3.9	*Refresh Rate*	60 min	15 min
3.5.9.3.10	*Data Latency*	TBS	TBS
3.5.9.3.11	*Long-term Stability*	TBS	TBS

3.5.9.4 SNOW COVER: GLOBAL

3.5.9.4.1 Definition

Horizontal extent of snow cover. Fraction of an area covered by snow. Unit of measurement is percent (%) *[from Manual of the CEOS/WMO Database on User Requirements and IN SITU and Space Capabilities, Issue 1.4 - Aug 200]*.

3.5.9.4.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.4.3	*User & Priority (LO-#)*	Climate-2 DoD/USAF-1 DoD/USN&USMC-7 Europeans - UA	Climate-2 DoD/USAF-1 DoD/USN&USMC-7 Europeans - UA
3.5.9.4.4	*Geographic Coverage*	Global	Global
3.5.9.4.5	*Horizontal Resolution*	100 km	25 km
3.5.9.4.6	*Mapping Accuracy*	TBS	TBS
3.5.9.4.7	*Measurement Range*	TBS	TBS
3.5.9.4.8	*Measurement Accuracy*	TBS	5%
3.5.9.4.9	*Refresh Rate*	60 min	15 min
3.5.9.4.10	*Data Latency*	TBS	TBS
3.5.9.4.11	*Long-term Stability*	TBS	4%

3.5.9.5 SNOW DEPTH: CONUS

3.5.9.5.1 Definition

Snow depth pertains to the measurement of the amount of water in a given snow pack. It is the vertical distance between the top of a snow layer and the horizontal ground beneath [*Glossary of Meteorology*].

3.5.9.5.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.5.3	*User & Priority (LO-#)*	NWS/NOHRSC-1 NESDIS/ORA-2 NWS/NCEP/EMC-2 NESDIS/OSDPD-3 DoD/USA-1	NWS/NOHRSC-1 NESDIS/ORA-2 NWS/NCEP/EMC-2 NESDIS/OSDPD-3 DoD/USA-1
3.5.9.5.4	*Geographic Coverage*	CONUS	Hemispheric
3.5.9.5.5	*Horizontal Resolution*	4 km	0.5 km
3.5.9.5.6	*Mapping Accuracy*	1 km	0.2 km
3.5.9.5.7	*Measurement Range*	TBS	0 - 20 m
3.5.9.5.8	*Measurement Accuracy*	TBS	0.5 cm
3.5.9.5.9	*Refresh Rate*	60 min	30 min
3.5.9.5.10	*Data Latency*	60 min	30 min

3.5.9.6 SNOW DEPTH: GLOBAL

3.5.9.6.1 Definition

See requirement definition above.

3.5.9.6.2 P^3I Justification

To address this requirement both an active sensing instrument (synthetic aperture radar) and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.6.3	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.5.9.6.4	*Geographic Coverage*	Global	Global
3.5.9.6.5	*Horizontal Resolution*	TBS	1 km
3.5.9.6.6	*Mapping Accuracy*	TBS	1 km
3.5.9.6.7	*Measurement Range*	TBS	0 - 1 m
3.5.9.6.8	*Measurement Accuracy*	TBS	±4 cm
3.5.9.6.9	*Refresh Rate*	TBS	180 min
3.5.9.6.10	*Data Latency*	TBS	15 min

3.5.9.7 SNOW DEPTH: HEMISPHERIC

3.5.9.7.1 Definition

See requirement definition above.

3.5.9.7.2 P^3I Justification

To address this requirement an active sensing instrument (synthetic aperture radar) is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.7.3	*User & Priority (LO-#)*	NWS/NOHRSC-1 NESDIS/ORA-2 NESDIS/OSDPD-3 DoD/USA-1 DoD/USAF-1	NWS/NOHRSC-1 NESDIS/ORA-2 NESDIS/OSDPD-3 DoD/USA-1 DoD/USAF-1
3.5.9.7.4	*Geographic Coverage*	Hemispheric	Hemispheric
3.5.9.7.5	*Horizontal Resolution*	4 km	0.5 km
3.5.9.7.6	*Mapping Accuracy*	1 km	0.2 km
3.5.9.7.7	*Measurement Range*	TBS	0 - 20 m
3.5.9.7.8	*Measurement Accuracy*	TBS	0.5 cm
3.5.9.7.9	*Refresh Rate*	60 min	30 min
3.5.9.7.10	*Data Latency*	60 min	30 min

3.5.9.8 SNOW DEPTH: MESOSCALE

3.5.9.8.1 Definition

See requirement definition above.

3.5.9.8.2 P^3I Justification

To address this requirement an active sensing instrument (synthetic aperture radar) is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.8.3	*User & Priority (LO-#)*	DoD/USA-1	DoD/USA-1
3.5.9.8.4	*Geographic Coverage*	Mesoscale	Mesoscale
3.5.9.8.5	*Horizontal Resolution*	TBS	1 km
3.5.9.8.6	*Mapping Accuracy*	TBS	1 km
3.5.9.8.7	*Measurement Range*	TBS	0 - 90 cm
3.5.9.8.8	*Measurement Accuracy*	TBS	±2.5 cm
3.5.9.8.9	*Refresh Rate*	TBS	180 min
3.5.9.8.10	*Data Latency*	TBS	30 min

3.5.9.9 SNOW WATER EQUIVALENT: CONUS

3.5.9.9.1 Definition

Snow Water Equivalent (SWE) pertains to the measurement of the amount of water in a given snow pack. It is the depth of water that would result from the melting of the snow pack or of a snow sample [*Glossary of Meteorology*].

3.5.9.9.2 P^3I Justification

To address this requirement an active sensing instrument (synthetic aperture radar) is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.9.3	*User & Priority (LO-#)*	NWS/NOHRSC-1 NWS/NCEP/EMC-2 NESDIS/ORA-2 NESDIS/OSDPD-3	NWS/NOHRSC-1 NWS/NCEP/EMC-2 NESDIS/ORA-2 NESDIS/OSDPD-3
3.5.9.9.4	*Geographic Coverage*	CONUS	Hemispheric
3.5.9.9.5	*Sensing Depth / Vertical Resolution*	TBS	TBS
3.5.9.9.6	*Horizontal Resolution*	4 km	0.5 km
3.5.9.9.7	*Mapping Accuracy*	1 km	0.2 km
3.5.9.9.8	*Measurement Range*	0 - 10 m	0 - 20 m
3.5.9.9.9	*Measurement Accuracy*	1 cm	0.5 cm
3.5.9.9.10	*Refresh Rate*	60 min	30 min
3.5.9.9.11	*Data Latency*	60 min	30 min

3.5.9.10 SNOW WATER EQUIVALENT: HEMISPHERIC

3.5.9.10.1 Definition

See requirement definition above.

3.5.9.10.2 P^3I Justification

To address this requirement an active sensing instrument (synthetic aperture radar) is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.10.3	*User & Priority (LO-#)*	NWS/NOHRSC-1 NESDIS/ORA-2 NESDIS/OSDPD-3 Hydrology Program - UA	NWS/NOHRSC-1 NESDIS/ORA-2 NESDIS/OSDPD-3 Hydrology Program - UA
3.5.9.10.4	*Geographic Coverage*	Hemispheric	Hemispheric
3.5.9.10.5	*Sensing Depth / Vertical Resolution*	TBS	TBS
3.5.9.10.6	*Horizontal Resolution*	4 km	0.5 km
3.5.9.10.7	*Mapping Accuracy*	1 km	0.2 km
3.5.9.10.8	*Measurement Range*	0 - 10 m	0 - 20 m
3.5.9.10.9	*Measurement Accuracy*	1 cm	0.5 cm
3.5.9.10.10	*Refresh Rate*	60 min	30 min
3.5.9.10.11	*Data Latency*	60 min	30 min

3.5.9.11 SOIL MOISTURE: CONUS

3.5.9.11.1 Definition

Soil moisture is the moisture contained in the portion of the soil that is above the water table, including water vapor, which is present in the soil pores. Soil moisture content is the percentage of water in soil, expressed on a dry-weight basis or by volume; i.e., the volumetric fraction of water contained in the top part of the soil column. (Note: the top part of the soil column is the upper two to five centimeters of soil.) Soil moisture is a unit-less quantity and ranges from 0 to 0.6. [*UNESCO/WMO*]

3.5.9.11.2 *P^3I Justification*

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.11.3	*User & Priority (LO-#)*	NESDIS/ORA-2 NWS/NCEP/EMC-2 NESDIS/OSDPD-3	NESDIS/ORA-2 NWS/NCEP/EMC-2 NESDIS/OSDPD-3
3.5.9.11.4	*Geographic Coverage*	CONUS	Hemispheric
3.5.9.11.5	*Sensing Depth / Vertical Resolution*	TBS	TBS
3.5.9.11.6	*Horizontal Resolution*	20 km	2 km
3.5.9.11.7	*Mapping Accuracy*	5 km	1 km
3.5.9.11.8	*Measurement Range*	0.1 - 0.6 volumetric units	0.05 - 0.7 volumetric units
3.5.9.11.9	*Measurement Accuracy*	0.05 volumetric for top 2 cm of soil	0.02 volumetric for top 5 cm of soil
3.5.9.11.10	*Refresh Rate*	60 min	30 min
3.5.9.11.11	*Data Latency*	60 min	30 min

3.5.9.12 SOIL MOISTURE: GLOBAL

3.5.9.12.1 *Definition*

See requirement definition above.

3.5.9.12.2 *P^3I Justification*

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not components of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.12.3	*User & Priority (LO-#)*	DoD/USAF-1 DoD/USN&USMC-6 Europeans-UA	DoD/USAF-1 DoD/USN&USMC-6 Europeans-UA
3.5.9.12.4	*Geographic Coverage*	Global	Global
3.5.9.12.5	*Sensing Depth / Vertical Resolution*	TBS	5 cm
3.5.9.12.6	*Horizontal Resolution*	1 km	0.5 km
3.5.9.12.7	*Mapping Accuracy*	Clr: 1 km Cldy: 5 km	0.5 km
3.5.9.12.8	*Measurement Range*	TBS	TBS
3.5.9.12.9	*Measurement Accuracy*	TBS	TBS
3.5.9.12.10	*Refresh Rate*	8 hours	180 min
3.5.9.12.11	*Data Latency*	90 min	15 min

3.5.9.13 SOIL MOISTURE: HEMISPHERIC

3.5.9.13.1 Definition

See requirement definition above.

3.5.9.13.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.13.3	*User & Priority (LO-#)*	Hydrology Program - UA DoD/USN&USMC-6 Europeans-UA	Hydrology Program - UA DoD/USN&USMC-6 Europeans-UA
3.5.9.13.4	*Geographic Coverage*	Hemispheric	Global
3.5.9.13.5	*Sensing Depth / Vertical Resolution*	20 cm	50 cm
3.5.9.13.6	*Horizontal Resolution*	1 km	0.5 km
3.5.9.13.7	*Mapping Accuracy*	Clr: 1 km Cldy: 5 km	0.2 km
3.5.9.13.8	*Measurement Range*	TBS	0.1 to 0.7 cm
3.5.9.13.9		TBS	TBS
3.5.9.13.10	*Refresh Rate*	8 hours	60 min
3.5.9.13.11	*Data Latency*	90 min	30 min

3.5.9.14 SURFACE ALBEDO: GLOBAL

3.5.9.14.1 Definition

Measurement of the ratio of the amount of spectrum electromagnetic radiation reflected in the 0.4 - 4.0 μm band reflected by the earth to the amount incident upon it. This parameter is required during daytime only and under clear conditions only.

3.5.9.14.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.14.3	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.5.9.14.4	*Geographic Coverage*	TBS	Global
3.5.9.14.5	*Horizontal Resolution*	TBS	0.5 km
3.5.9.14.6	*Mapping Accuracy*	TBS	1 km
3.5.9.14.7	*Measurement Range*	TBS	0% to 100%
3.5.9.14.8	*Measurement Accuracy*	TBS	±1.25%
3.5.9.14.9	*Refresh Rate*	TBS	60 min
3.5.9.14.10	*Data Latency*	TBS	60 min

3.5.9.15 SURFACE TYPE: GLOBAL

3.5.9.15.1 Definition

Land surface type (or land cover) relates to the type of feature present on the surface of the earth. Surface type classes define the land in some way, such as by slope, land cover type, etc. [*NASA Global Change Master Directory*].

3.5.9.15.2 P³I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not components of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.15.3	*User & Priority (LO-#)*	DoD/USAF-1	DoD/USAF-1
3.5.9.15.4	*Geographic Coverage*	Global	Global
3.5.9.15.5	*Horizontal Resolution*	TBS	1 km
3.5.9.15.6	*Mapping Accuracy*	TBS	1 km
3.5.9.15.7	*Measurement Range*	TBS	17 IGBP classes
3.5.9.15.8	*Measurement Accuracy*	TBS	98%
3.5.9.15.9	*Refresh Rate*	TBS	180 min
3.5.9.15.10	*Data Latency*	TBS	15 min

3.5.9.16 TRUE COLOR PRODUCT: GLOBAL

3.5.9.16.1 Definition

[TBW]

3.5.9.16.2 P^{3}I Justification

To address this requirement both an extra visible imagery channel and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.16.3	*User & Priority (LO-#)*	NESDIS/OSDPD-2 NESDIS/ORA-3	NESDIS/OSDPD-2 NESDIS/ORA-3
3.5.9.16.4	*Geographic Coverage*	Hemispheric	Global
3.5.9.16.5	*Horizontal Resolution*	2 km	0.5 km
3.5.9.16.6	*Mapping Accuracy*	0.5 km	0.2 km
3.5.9.16.7	*Measurement Range*	TBS	TBS
3.5.9.16.8	*Measurement Accuracy*	TBS	TBS
3.5.9.16.9	*Refresh Rate*	60 min	5 min
3.5.9.16.10	*Data Latency*	1 min	1 min

3.5.9.17 TRUE COLOR PRODUCT: HEMISPHERIC

3.5.9.17.1 Definition

[TBW]

3.5.9.17.2 P^{3}I Justification

To address this requirement both an extra visible imagery channel and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.9.17.3	*User & Priority (LO-#)*	NESDIS/OSDPD-2 NESDIS/ORA-2	NESDIS/OSDPD-2 NESDIS/ORA-2
3.5.9.17.4	*Geographic Coverage*	CONUS	Hemispheric
3.5.9.17.5	*Horizontal Resolution*	4 km	2 km
3.5.9.17.6	*Mapping Accuracy*	1 km	0.2 km
3.5.9.17.7	*Measurement Range*	0 - 1	0 - 1
3.5.9.17.8	*Measurement Accuracy*	0.04	0.2
3.5.9.17.9	*Refresh Rate*	60 min	30 min
3.5.9.17.10	*Data Latency*	60 min	30 min

3.5.10 Performance Characteristics: Ocean

3.5.10.1 CURRENTS: GLOBAL

3.5.10.1.1 Definition

Ocean currents are defined as large-scale movements of the surface waters of the ocean driven by wind. The types of current that shall be measured are tidal, permanent, wave-induced, wind-induced, longshore and rip currents. Currents are a vector quantity with both speed and direction. This product is required under all weather and lighting conditions.

Attribute		Threshold	Objective
3.5.10.1.2	*User & Priority Category*	NWS/NCEP/OPC-1	NWS/NCEP/OPC-1
3.5.10.1.3	*Geographic Coverage*	Global	Global
3.5.10.1.4	*Sensing Depth*	Surface	Surface
3.5.10.1.5	*Horizontal Resolution*	2 km	2 km
3.5.10.1.6	*Mapping Accuracy*	0.5 km	0.5 km
3.5.10.1.7	*Measurement Range*	0 - 5 m/s	0 - 5 m/s
3.5.10.1.8	*Measurement Accuracy*	1 km/hr	1 km/hr
3.5.10.1.9	*Refresh Rate*	6 hr	60 min
3.5.10.1.10	*Data Latency*	60 min	15 min

3.5.10.2 CURRENTS: OFFSHORE / GLOBAL

3.5.10.2.1 Definition

See requirement definition above.

This product is required under all weather and lighting conditions.

3.5.10.2.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.10.2.3	*User & Priority Category*	NWS/NCEP/OPC-1 DoD/USA-1	NWS/NCEP/OPC-1 DoD/USA-1
3.5.10.2.4	*Geographic Coverage*	Global	Global
3.5.10.2.5	*Sensing Depth*	Surface	Surface
3.5.10.2.6	*Horizontal Resolution*	2 km	2 km
3.5.10.2.7	*Mapping Accuracy*	0.5 km	0.5 km
3.5.10.2.8	*Measurement Range*	0 - 5 m/s	0 - 5 m/s
3.5.10.2.9	*Measurement Accuracy*	1 km/hr	1 km/hr
3.5.10.2.10	*Refresh Rate*	6 hr	60 min
3.5.10.2.11	*Data Latency*	60 min	15 min

3.5.10.3 OCEAN COLOR (TURBIDITY/CHLOROPHYLL/REFLECTANCE): GLOBAL

3.5.10.3.1 Definition

Ocean color is defined as the spectrum of water-leaving radiances (Lw), i.e., the portion of visible - near infrared light that is reflected out of the water column, excluding light reflected at the surface. All geophysical quantities of interest, e.g., the concentration of the phytoplankton pigment chlorophyll a (chlorophyll-a), turbidity and reflectance are derived from these Lw values. Water-leaving radiances are measured in W m^{-2} μm^{-1} sr^{-1}. Chlorophyll a is measured in mg m^{-3}.

3.5.10.3.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.10.3.3	*User & Priority Category*	Climate-2	Climate-2
3.5.10.3.4	*Geographic Coverage*	Global	Global
3.5.10.3.5	*Horizontal Resolution*	100 km	25 km
3.5.10.3.6	*Mapping Accuracy*	TBS	TBS
3.5.10.3.7	*Measurement Range*	TBS	TBS
3.5.10.3.8	*Measurement Accuracy*	TBS	5%
3.5.10.3.9	*Refresh Rate*	60 min	15 min
3.5.10.3.10	*Data Latency*	TBS	TBS
3.5.10.3.11	*Long-term Stability*	TBS	1%

3.5.10.4 OCEAN TURBIDITY: GLOBAL

3.5.10.4.1 Definition

Turbidity is a measurement of the degree of scattering of light in water, related to the amount of suspended material in the water. Highly turbid ocean waters are those with a large number of scattering particulates in them. In both highly absorbing and highly scattering waters, visibility into the water is reduced. The highly scattering (turbid) water still reflects a lot of light while the highly absorbing water, such as a black water lake, is very dark. The scattering particles that cause the water to be turbid can be composed of many things, including sediments and phytoplankton. The turbidity is quantified as the percent reflected light emerging from the water column in a range of 0 to 8 percent [*Ocean Turbidity*].

3.5.10.4.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.10.4.3	*User & Priority Category*	DoD/USN-USMC-4	DoD/USN-USMC-4
3.5.10.4.4	*Geographic Coverage*	Global	Global
3.5.10.4.5	*Sensing Depth*	0 to -10 m	0 to -100 m
3.5.10.4.6	*Horizontal Resolution*	5 km	2 km
3.5.10.4.7	*Mapping Accuracy*	5 km	TBS
3.5.10.4.8	*Measurement Range*	0 to 100 mg/m^3	TBS
3.5.10.4.9	*Measurement Accuracy*	10 mg/m^3	3 mg/m^3
3.5.10.4.10	*Refresh Rate*	180 min	TBS
3.5.10.4.11	*Data Latency*	60 min	TBS

3.5.10.5 SEA AND LAKE ICE / AGE: GLOBAL

3.5.10.5.1 Definition

The age of the sea ice is usually a distinction between first-year and multiyear ice. Multiyear sea ice is usually thicker, has more ridges, and can be more of a hindrance to ship travel than first-year ice [*Canadian Ice Service. See also Hall and Martinec*].

3.5.10.5.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.10.5.3	*User & Priority Category*	DoD/USAF-1	DoD/USAF-1
3.5.10.5.4	*Geographic Coverage*	Global	Global
3.5.10.5.5	*Sensing Depth*	TBS	Ice Surface
3.5.10.5.6	*Horizontal Resolution*	TBS	1 km
3.5.10.5.7	*Mapping Accuracy*	TBS	1 km
3.5.10.5.8	*Measurement Range*	TBS	Distinguish between Ice free, Nilas, Grey White, First Year Medium, First Year Thick, Second Year, and Multiyear Smooth and Deformed Ice
3.5.10.5.9	*Measurement Accuracy*	TBS	95% (90% for sea Ice)
3.5.10.5.10	*Refresh Rate*	TBS	180 min
3.5.10.5.11	*Data Latency*	TBS	15 min

3.5.10.6 SEA AND LAKE ICE / CONCENTRATION: GLOBAL

3.5.10.6.1 Definition

Concentration of the ice is defined as "The ratio expressed in tenths describing the amount of the sea surface covered by ice as a fraction of the whole area being considered. Total concentration includes all stages of development that are present. Partial concentration may refer to the amount of a particular stage or of a particular form of ice and represents only a part of the total." The concentration of sea ice varies within the ice pack due to deformation, new ice development, melting, breaking apart and ice motion. The motion of the ice is affected by various meteorological and oceanographic factors but primarily by the surface winds and surface ocean currents. The total concentration is expressed in tenths from 0/10s to 10/10s, either as a single number or as a range of numbers (e.g. 4-6/10s).

3.5.10.6.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute		Threshold	Objective
3.5.10.6.3	*User & Priority Category*	NESDIS/OSDPD/NIC-1 DoD/USAF-1	NESDIS/OSDPD/NIC-1 DoD/USAF-1
3.5.10.6.4	*Geographic Coverage*	Global	Global
3.5.10.6.5	*Sensing Depth*	TBS	TBS
3.5.10.6.6	*Horizontal Resolution*	10 km	5 km
3.5.10.6.7	*Mapping Accuracy*	≤ 5 km	≤ 2.5 km
3.5.10.6.8	*Measurement Range*	Ice concentration - 0/10 to 10/10	Ice concentration - 0/10 to 10/10
3.5.10.6.9	*Measurement Accuracy*	Ice extent 1 km Ice concentration - 10%	Ice extent 1km Ice concentration - 10%
3.5.10.6.10	*Refresh Rate*	6 hours	180 min
3.5.10.6.11	*Data Latency*	180 min	30 min

3.5.10.7 SEA AND LAKE ICE / DISPLACEMENT AND DIRECTION: GLOBAL

3.5.10.7.1 Definition

Refers to the magnitude/distance and direction of sea and lake ice fields or floes. Ice motion processes include: diverging, compacting, and shearing [*Canadian Ice Service; European Space Agency*].

3.5.10.7.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture

Attribute		Threshold	Objective
3.5.10.7.3	*User & Priority Category*	DoD/USAF-1	DoD/USAF-1
3.5.10.7.4	*Geographic Coverage*	Global	Global
3.5.10.7.5	*Horizontal Resolution*	TBS	1 km
3.5.10.7.6	*Mapping Accuracy*	TBS	1 km
3.5.10.7.7	*Measurement Range*	TBS	0 to 75 km/day
3.5.10.7.8	*Measurement Accuracy*	TBS	0.1 km/day
3.5.10.7.9	*Refresh Rate*	TBS	180 min
3.5.10.7.10	*Data Latency*	TBS	15 min

3.5.10.8 SEA AND LAKE ICE / EXTENT AND EDGE: GLOBAL

3.5.10.8.1 Definition

Sea and lake ice extent is defined as the limit of the sea or lake ice, respectively, from the landmass to the ice edge (s). The Ice Edge is officially defined by the WMO (Pub. 259. 259TP145) as the "demarcation at any given time between the open sea and sea ice of any kind, whether fast or drifting." In practical terms, the ice edge marks the limit of all known ice. The ice edge is a critical region for safety of navigation and commerce.

3.5.10.8.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture

Attribute		Threshold	Objective
3.5.10.8.3	*User & Priority Category*	NWS/NCEP/OPC-1 NESDIS/OSDPD/NIC-1	NWS/NCEP/OPC-1 NESDIS/OSDPD/NIC-1
3.5.10.8.4	*Geographic Coverage*	Hemispheric - Sea ice covered waters in the Northern and Southern Hemispheres	Global - Sea ice covered waters in the Northern and Southern Hemispheres
3.5.10.8.5	*Horizontal Resolution*	Day: 400 m Night: 800 m	Day: 250 m Night: 250 m
3.5.10.8.6	*Mapping Accuracy*	Day: ≤ 400 m Night: ≤ 800 m	Day: ≤ 250 m Night: ≤ 250 m
3.5.10.8.7	*Measurement Range*	Presence of Ice (day): Reflectance at 420-750 nm Presence of Ice (night): 10 - 12 µm	Presence of Ice (day): Reflectance at 420-750 nm Presence of Ice (night): 10 - 12 µm
3.5.10.8.8	*Measurement Accuracy*	10%	5%
3.5.10.8.9	*Refresh Rate*	12 hours	180 min
3.5.10.8.10	*Data Latency*	180 min	30 min

3.5.10.9 SEA AND LAKE ICE / EXTENT AND CHARACTERIZATION: GLOBAL

3.5.10.9.1 Definition

See requirement definition above.

3.5.10.9.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture

Attribute		Threshold	Objective
3.5.10.9.3	*User & Priority Category*	NMAO/Ships-2 DoD/USAF-1	NMAO/Ships-2 DoD/USAF-1
3.5.10.9.4	*Geographic Coverage*	TBS	Global - Arctic, Antarctic
3.5.10.9.5	*Sensing Depth or Vertical Coverage*	TBS	Surface
3.5.10.9.6	*Horizontal Resolution*	TBS	TBS
3.5.10.9.7	*Mapping Accuracy*	TBS	TBS
3.5.10.9.8	*Measurement Range*	TBS	TBS
3.5.10.9.9	*Measurement Accuracy*	TBS	TBS
3.5.10.9.10	*Refresh Rate*	TBS	60 min
3.5.10.9.11	*Data Latency*	TBS	15 min

3.5.10.10 SEA AND LAKE ICE / MOTION: GLOBAL

3.5.10.10.1 Definition

Sea and lake ice motion is the instantaneous measurement of the direction and magnitude of the movement of the ice. The direction of the ice motion is normally expressed as degrees from 1-360. The magnitude of the ice motion is normally expressed in meters per second or in nautical miles per hour.

3.5.10.10.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture

Attribute		Threshold	Objective
3.5.10.10.3	*User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.5.10.10.4	*Geographic Coverage*	Global - Sea ice covered waters in N. & S. Hemispheres	Global - Sea ice covered waters in N. & S. Hemispheres
3.5.10.10.5	*Horizontal Resolution*	15 km	10 km
3.5.10.10.6	*Mapping Accuracy*	≤ 7.5 km	≤ 5 km
3.5.10.10.7	*Measurement Range*	Direction: 0 - 360° Displacement: 0 m/s to 0.6 m/s	Direction: 0 - 360° Displacement: 0 m/s to 0.6 m/s
3.5.10.10.8	*Measurement Accuracy*	Direction: ± 15°	Direction: ± 10°
3.5.10.10.9	*Refresh Rate*	6 hours	180 min
3.5.10.10.10	*Data Latency*	180 min	30 min

3.5.10.11 SEA AND LAKE ICE / SURFACE TEMPERATURE: GLOBAL

3.5.10.11.1 Definition

Measurements of the temperature of the sea ice and surrounding sea surface temperature [*Hall and Martinec*].

3.5.10.11.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.11.3 *User & Priority Category*	NESDIS/OSDPD/NIC - UA Europeans - UA	NESDIS/OSDPD/NIC - UA Europeans - UA
3.5.10.11.4 *Geographic Coverage*	Global - Sea ice covered waters in the Northern and Southern Hemispheres	Global - Sea ice covered waters in the Northern and Southern Hemispheres
3.5.10.11.5 *Horizontal Resolution*	0.5 km	0.25 km
3.5.10.11.6 *Mapping Accuracy*	≤ 0.5 km	≤ 0.25 km
3.5.10.11.7 *Measurement Range*	213 - 280 K	213 - 280 K
3.5.10.11.8 *Measurement Accuracy*	0.5 K	0.5 K
3.5.10.11.9 *Refresh Rate*	6 hours	180 min
3.5.10.11.10 *Data Latency*	180 min	30 min

3.5.10.12 SEA AND LAKE ICE / THICKNESS: GLOBAL

3.5.10.12.1 Definition

Sea and lake ice thickness is the vertical thickness of an ice floe, sheet of ice or area of newly forming ice. The thickness is normally measured in centimeters. Optimally, ice thickness should be measured directly. Ice thickness can be inferred from the age or stage of development of the ice. Certain characteristics of the ice are captured from remotely sensed imagery. The shape of the ice floes; the appearance of the surface in reflected light (visible imagery); the temperature of the ice (infrared imagery); appearance of surface melting; frost flowers; topography, freeboard and fracturing (active radar imagery); and the emissivity values (passive microwave) are all valuable parameters that are used to gauge the stage of development. These parameters combine to estimate the thickness of the ice. The stage of development describes the properties of the sea ice that are determined by the thickness and age of the ice. The ice assumes various characteristics of elasticity, tensile strength and probability of deformation in certain ways. The danger to shipping increases as it thickens and ages. Due to its hardness and strength, ice that has lasted over at least one summer melt season assumes many of the characteristics of ice of land origin or icebergs making it very dangerous to shipping.

3.5.10.12.2 P³I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.12.3 *User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.5.10.12.4 *Geographic Coverage*	FULL DISK - Sea ice covered waters in the Northern and Southern Hemispheres	Global - Sea ice covered waters in the Northern and Southern Hemispheres
3.5.10.12.5 *Sensing Depth*	Ice Surface	Ice Surface
3.5.10.12.6 *Horizontal Resolution*	10 km	5 km
3.5.10.12.7 *Mapping Accuracy*	≤ 5 km	≤ 2.5 km
3.5.10.12.8 *Measurement Range*	Age: 0-3 yrs Thickness: 0 - 6 m	Age: 0-3 yrs Thickness: 0 - 6 m
3.5.10.12.9 *Measurement Accuracy*	Ice Stage: ± 30 cm	Ice Stage: ± 30 cm
3.5.10.12.10 *Refresh Rate*	6 hours	180 min
3.5.10.12.11 *Data Latency*	6 hours	180 min

3.5.10.13 SEA AND LAKE SURFACE WIND: CONUS

3.5.10.13.1 Definition

Sea and lake surface winds are defined as movements of the air over the sea surface, associated primarily with the large-scale synoptic wind fields over the ocean or the continental land mass, respectively. In addition to advecting ice, sea and lake surface winds are responsible for generating waves and currents in the ocean and lakes and for affecting air-sea fluxes of properties (such as momentum, heat, and moisture). Winds are a vector quantity with both speed and direction and measured in units of meters/second (m/s).

3.5.10.13.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.13.3 *User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.5.10.13.4 *Geographic Coverage*	CONUS	CONUS
3.5.10.13.5 *Sensing Depth or Vertical Coverage*	0 to 10 m	0 to 10 m
3.5.10.13.6 *Horizontal Resolution*	5 km	1 km
3.5.10.13.7 *Mapping Accuracy*	≤ 2.5 m	≤ 1.0 m
3.5.10.13.8 *Measurement Range*	3 - 40 m/s 0 - 360º	3 - 40 m/s 0 - 360º
3.5.10.13.9 *Measurement Accuracy*	10 %	5 %
3.5.10.13.10 *Refresh Rate*	180 min	60 min
3.5.10.13.11 *Data Latency*	60 min	30 min

3.5.10.14 SEA AND LAKE SURFACE WIND: HEMISPHERIC

3.5.10.14.1 Definition

See requirement definition above.

3.5.10.14.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.14.3 *User & Priority Category*	NESDIS/OSDPD/NIC-1	NESDIS/OSDPD/NIC-1
3.5.10.14.4 *Geographic Coverage*	Hemispheric	Hemispheric
3.5.10.14.5 *Sensing Depth or Vertical Coverage*	0 to 10 m	0 to 10 m
3.5.10.14.6 *Horizontal Resolution*	10 km	5 km
3.5.10.14.7 *Mapping Accuracy*	≤ 5 m	≤ 2.5 m
3.5.10.14.8 *Measurement Range*	3 - 40 m/s 0 - 360º	3 - 40 m/s 0 - 360º
3.5.10.14.9 *Measurement Accuracy*	10 %	5 %
3.5.10.14.10 *Refresh Rate*	6 hours	180 min
3.5.10.14.11 *Data Latency*	60 min	30 min

3.5.10.15 SEA SURFACE TEMPERATURE: COASTAL

3.5.10.15.1 Definition

The skin temperature of the ocean at depths on the order of 10 μm.

Coastal coverage refers to the areal extent consistent with the U.S. Exclusive Economic Zones (EEZ) that extend 370 km from shore. Coastal waters defined as far inland as the top of the

watershed. The location for coastal SST is defined as the area of U.S. navigable waters seaward to the continental shelf break.

Attribute	Threshold	Objective
3.5.10.15.2 *User & Priority Category*	NESDIS/ORA-1 NMFS/ALL-1 NOS/ALL-1	NESDIS/ORA-1 NMFS/ALL-1 NOS/ALL-1
3.5.10.15.3 *Geographic Coverage*	U.S. navigable waters thru EEZ	U.S. navigable waters thru EEZ
3.5.10.15.4 *Horizontal Resolution*	1 km	30 m
3.5.10.15.5 *Mapping Accuracy*	0.5 km	<30 m
3.5.10.15.6 *Measurement Range*	271 - 313 K	270 - 313 K
3.5.10.15.7 *Measurement Accuracy*	0.5 K	0.1 K
3.5.10.15.8 *Refresh Rate*	180 min	30 min
3.5.10.15.9 *Data Latency*	180 min	15 min

3.5.10.16 SEA SURFACE TEMPERATURE: GLOBAL

3.5.10.16.1 Definition

See requirement definition above.

3.5.10.16.2 P^3I Justification

To address this requirement a global constellation of geostationary satellites, or equivalent capability, is required but currently not a component of the GOES-R notional baseline architecture

Attribute	Threshold	Objective
3.5.10.16.3 *User & Priority Category*	NESDIS/ORA-1 NWS/NCEP/OPC-1 Climate-2 NMAO/Ships-2 DoD/USAF-1 Europeans - UA	NESDIS/ORA-1 NWS/NCEP/OPC-1 Climate-2 NMAO/Ships-2 DoD/USAF-1 Europeans - UA
3.5.10.16.4 *Geographic Coverage*	Global	Global
3.5.10.16.5 *Sensing Depth or Vertical Coverage*	Surface	Surface
3.5.10.16.6 *Horizontal Resolution*	2 km	0.5 km
3.5.10.16.7 *Mapping Accuracy*	1 km	0.2 km
3.5.10.16.8 *Measurement Range*	271-313 K	270 - 313 K
3.5.10.16.9 *Measurement Accuracy*	1 K	0.1 K
3.5.10.16.10 *Refresh Rate*	60 min	15 min
3.5.10.16.11 *Data Latency*	180 min	5 min
3.5.10.16.12 *Long-term Stability*	TBS	0.04 K

3.5.10.17 SEA SURFACE WINDS: COASTAL

3.5.10.17.1 Definition

Measure of atmospheric wind speed and direction at the sea/atmosphere interface (ten meter height neutral stability winds) in clear sky and cloudy conditions.

Coastal coverage refers to the areal extent consistent with the U.S. Exclusive Economic Zones (EEZ) that extend 370 km from shore. Coastal waters defined as far inland as the top of the watershed. The location for coastal sea surface winds is defined as the area of U.S. navigable waters seaward to the continental shelf break.

3.5.10.17.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.17.3 *User & Priority Category*	NOS/OCS-1 NOS/ORR-1 NOS/CO-OPS-1 NOS/OCRM-1 NWS/NCEP/OPC-1	NOS/OCS-1 NOS/ORR-1 NOS/CO-OPS-1 NOS/OCRM-1 NWS/NCEP/OPC-1
3.5.10.17.4 *Geographic Coverage*	U.S. navigable waters thru EEZ	U.S. navigable waters thru EEZ
3.5.10.17.5 *Sensing Depth*	10 m - surface	10 m - surface
3.5.10.17.6 *Horizontal Resolution*	5 km	300 m
3.5.10.17.7 *Mapping Accuracy*	1 km	$<$ 300 m
3.5.10.17.8 *Measurement Range*	0 to 60 m/s, 0º - 360º	0 to 50 m/s, 0º - 360º
3.5.10.17.9 *Measurement Accuracy*	1 m/s	0.3 m/s
3.5.10.17.10 *Refresh Rate*	60 min	6 min
3.5.10.17.11 *Data Latency*	15 min	1 min

3.5.10.18 SEA SURFACE WINDS: CONUS/OFFSHORE

3.5.10.18.1 Definition

See requirement definition above.

Offshore surface currents are defined as large-scale movements of the surface waters of the ocean farther than 100 km offshore.

3.5.10.18.2 P^3I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.18.3 *User & Priority Category*	NOS/OCS-1 NOS/ORR-1 NWS/NCEP/OPC-1 NESDIS/OSDPD/NIC – UA	NOS/OCS-1 NOS/ORR-1 NWS/NCEP/OPC-1 NESDIS/OSDPD/NIC - UA
3.5.10.18.4 *Geographic Coverage*	CONUS	CONUS
3.5.10.18.5 *Sensing Depth*	Surface – 10 m	Surface – 10 m
3.5.10.18.6 *Horizontal Resolution*	10 km	1 km
3.5.10.18.7 *Mapping Accuracy*	1 km	<1 km
3.5.10.18.8 *Measurement Range*	0 to 50 m/s, 0º - 360º	0 to 60 m/s, 0º - 360º
3.5.10.18.9 *Measurement Accuracy*	1 m/s 10°	1 m/s 10°
3.5.10.18.10 *Refresh Rate*	60 min	30 min
3.5.10.18.11 *Data Latency*	15 min	5 min

3.5.10.19 SEA SURFACE WINDS: GLOBAL

3.5.10.19.1 Definition

See requirement definition above.

3.5.10.19.2 P^3I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.19.3 *User & Priority Category*	NESDIS/ORA-1 NWS/NCEP/OPC-1 NMAO/Ships-2 NESDIS/OSDPD/NIC - UA	NESDIS/ORA-1 NWS/NCEP/OPC-1 NMAO/Ships-2 NESDIS/OSDPD/NIC - UA
3.5.10.19.4 *Geographic Coverage*	Global - Sea ice covered waters in the Northern and Southern Hemispheres	Global - Sea ice covered waters in the Northern and Southern Hemispheres
3.5.10.19.5 *Sensing Depth*	Sea Surface	Surface – 10 m
3.5.10.19.6 *Horizontal Resolution*	25 km	1 km
3.5.10.19.7 *Mapping Accuracy*	≤ 12.5 km	0.5 km
3.5.10.19.8 *Measurement Range*	3 to 35 m/s 0 to 360°	0 to 60 m/s 0 to 360°
3.5.10.19.9 *Measurement Accuracy*	Greater of 2 m/s or 10%, 20 deg for wind speed> 5 m/s, 25 deg for speeds 3-5 m/s	Greater of 1 m/s or 10%; 10°
3.5.10.19.10 *Refresh Rate*	6 hr	30 min
3.5.10.19.11 *Data Latency*	90 min	15 min

3.5.10.20 SEA SURFACE WINDS: HEMISPHERIC

3.5.10.20.1 Definition

See requirement definition above.

3.5.10.20.2 P³I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.20.3 *User & Priority Category*	NWS/NCEP/OPC-1 NWS/NCEP/TPC-1 NWS/WFO-1	NWS/NCEP/OPC-1 NWS/NCEP/TPC-1 NWS/WFO-1
3.5.10.20.4 *Geographic Coverage*	Full Disk	Full Disk
3.5.10.20.5 *Sensing Depth*	Surface to 10 m	Surface to 10 m
3.5.10.20.6 *Horizontal Resolution*	10 km	2 km
3.5.10.20.7 *Mapping Accuracy*	2 km	0.5 km
3.5.10.20.8 *Measurement Range*	0 - 150 kts 0º - 360°	0 - 150 kts 0º - 360°
3.5.10.20.9 *Measurement Accuracy*	1 m/s per 10°	1 m/s per 10°
3.5.10.20.10 *Refresh Rate*	60 min	15 min
3.5.10.20.11 *Data Latency*	15 min	1 min

3.5.10.21 SEA SURFACE WINDS: MESOSCALE

3.5.10.21.1 Definition

See requirement definition above.

3.5.10.21.2 P³I Justification

To address this requirement an instrument capable of sensing in the microwave region is required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.21.3 *User & Priority Category*	NWS/NCEP/OPC-1	NWS/NCEP/OPC-1
3.5.10.21.4 *Geographic Coverage*	Mesoscale	Mesoscale
3.5.10.21.5 *Sensing Depth*	Surface - 10 m	Surface - 10 m
3.5.10.21.6 *Horizontal Resolution*	10 km	5 km
3.5.10.21.7 *Mapping Accuracy*	1 km	1 km
3.5.10.21.8 *Measurement Range*	0 - 50 m/s, 0º - 360º	0 - 60 m/s, 0º - 360º
3.5.10.21.9 *Measurement Accuracy*	1 m/s per 10°	1 m/s per 10°
3.5.10.21.10 *Refresh Rate*	60 min	30 min
3.5.10.21.11 *Data Latency*	15 min	5 min

3.5.10.22 TRUE COLOR IMAGERY: GLOBAL

3.5.10.22.1 Definition

Images of the visible and near infrared part of the electromagnetic spectrum to which a "dark correction" and "Rayleigh correction" are applied; the data are calibrated, co-registered; and then the data are displayed as a "True Color" image [*SeaWifs Teachers Resources*].

3.5.10.22.2 P^3I Justification

To address this requirement both an instrument capable of sensing in the microwave region and a global constellation of geostationary satellites, or equivalent capability, are required but currently not a component of the GOES-R notional baseline architecture.

Attribute	Threshold	Objective
3.5.10.22.3 *User & Priority Category*	DoD/USN&USMC-UA	DoD/USN&USMC-UA
3.5.10.22.4 *Geographic Coverage*	Global	Global
3.5.10.22.5 *Sensing Depth*	TBS	TBS
3.5.10.22.6 *Horizontal Resolution*	TBS	TBS
3.5.10.22.7 *Mapping Accuracy*	TBS	TBS
3.5.10.22.8 *Measurement Range*	TBS	TBS
3.5.10.22.9 *Measurement Accuracy*	TBS	TBS
3.5.10.22.10 *Refresh Rate*	TBS	TBS
3.5.10.22.11 *Data Latency*	TBS	TBS

3.5.11 Performance Characteristics: Space / Energetic Particles

3.5.11.1 TOTAL ELECTRON CONTENT (TEC)

3.5.11.1.1 Definition

Total Electron Content (TEC) is the number of free electrons in a column of the earth's ionosphere.

3.5.11.1.2 P^3I Justification

Further study is required to establish the measurement technique and/or benefit of sensing this requirement from geostationary orbit. In addition, the current planned geostationary architecture does not provide sufficient viewing angle or coverage, other orbital/architectural options will be required for complete coverage.

Attribute		Threshold	Objective
3.5.11.1.3	*User & Priority Category*	DoD/All-1	DoD/All-1
3.5.11.1.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Global
3.5.11.1.5	*Spatial / Angular Resolution*	TBS	10 km
3.5.11.1.6	*Mapping Accuracy*	TBS	5 km
3.5.11.1.7	*Measurement Range*	TBS	1 - 200 TEC units
3.5.11.1.8	*Measurement Accuracy*	TBS	Greater of 1 TEC unit or 30%
3.5.11.1.9	*Refresh Rate*	TBS	0 - 50° N/S: 30 min >50° N/S: 15 min
3.5.11.1.10	*Data Latency*	TBS	15 min

3.5.12 Performance Characteristics: Space / Magnetosphere/Atmosphere

3.5.12.1 AURORAL BOUNDARY

3.5.12.1.1 Definition

Location of the equatorial boundary of the auroral zone.

3.5.12.1.2 P^3I Justification

The current planned geostationary architecture does not provide sufficient viewing angle or coverage for this requirement; other orbital/architectural options will be required for complete coverage.

Attribute		Threshold	Objective
3.5.12.1.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.1.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	>30° N/S Latitude
3.5.12.1.5	*Spatial / Angular Resolution*	TBS	10 km
3.5.12.1.6	*Mapping Accuracy*	TBS	25 km
3.5.12.1.7	*Measurement Range*	TBS	TBS
3.5.12.1.8	*Measurement Accuracy*	TBS	±10%
3.5.12.1.9	*Refresh Rate*	TBS	15 min
3.5.12.1.10	*Data Latency*	TBS	15 min

3.5.12.2 AURORAL EMISSIONS AND AIRGLOW

3.5.12.2.1 Definition

The Aurora is the sporadic radiant emission from the upper atmosphere over the middle and high latitudes. It is believed to be due primarily to the emission of the nitrogen molecule, its molecular ion, and atomic oxygen.

Airglow is the quasi-steady radiant emission from the upper atmosphere over middle and low latitudes, to be distinguished from the sporadic emission of auroras that occur over high latitudes. It is also called light-of-the-night-sky, night-sky light, night-sky luminescence, permanent aurora. [*Glossary of Meteorology*]

3.5.12.2.2 P³I Justification

Further study is required to establish the measurement technique and/or benefit of sensing this requirement from geostationary orbit. In addition, the current planned geostationary architecture does not provide sufficient viewing angle or coverage, other orbital/architectural options will be required for complete coverage.

Attribute		Threshold	Objective
3.5.12.2.3	*User & Priority Category*	DoD/All-1	DoD/All-1
3.5.12.2.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Auroral Emissions: >30° N/S Airglow: Global
3.5.12.2.5	*Spatial / Angular Resolution*	TBS	5 km
3.5.12.2.6	*Mapping Accuracy*	TBS	1 km
3.5.12.2.7	*Measurement Range*	TBS	TBS
3.5.12.2.8	*Measurement Accuracy*	TBS	±10%
3.5.12.2.9	*Refresh Rate*	TBS	Auroral Emissions: 15 min Airglow: 4 hr
3.5.12.2.10	*Data Latency*	TBS	5 min

3.5.12.3 AURORAL ENERGY DEPOSITION

3.5.12.3.1 Definition

Measure of the heat flux to the ionosphere from auroral particle precipitation.

3.5.12.3.2 P³I Justification

Further study is required to establish the measurement technique and/or benefit of sensing this requirement from geostationary orbit. In addition, the current planned geostationary architecture does not provide sufficient viewing angle or coverage, other orbital/architectural options will be required for complete coverage.

Attribute		Threshold	Objective
3.5.12.3.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.3.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	>30° N/S
3.5.12.3.5	*Spatial / Angular Resolution*	TBS	10 km
3.5.12.3.6	*Mapping Accuracy*	TBS	10 km
3.5.12.3.7	*Measurement Range*	TBS	Energy Range: 30 eV - 50 KeV Energy Flux: $5x10^{-5}$ - 1 W m^{-2}
3.5.12.3.8	*Measurement Accuracy*	TBS	Greater of $5x10^{-5}$ W/m^2 or 5%
3.5.12.3.9	*Refresh Rate*	TBS	15 min
3.5.12.3.10	*Data Latency*	TBS	15 min

3.5.12.4 AURORAL IMAGERY

3.5.12.4.1 Definition

Imagery used to specify the degree of auroral activity at locations within the auroral zones.

3.5.12.4.2 P^3I Justification

The current planned geostationary architecture does not provide sufficient viewing angle or coverage for this requirement; other orbital/architectural options will be required for complete coverage.

Attribute		Threshold	Objective
3.5.12.4.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.4.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	>30° N/S latitude
3.5.12.4.5	*Spatial / Angular Resolution*	TBS	10 km
3.5.12.4.6	*Mapping Accuracy*	TBS	10 km
3.5.12.4.7	*Measurement Range*	TBS	Wavelength: $2x10^{-3}$ - 10^2 µm Energy Flux: 0.25 - 50 ergs $cm^{-2}sec^{-1}$
3.5.12.4.8	*Measurement Accuracy*	TBS	±5%
3.5.12.4.9	*Refresh Rate*	TBS	15 min
3.5.12.4.10	*Data Latency*	TBS	15 min

3.5.12.5 ELECTRON DENSITY PROFILES

3.5.12.5.1 Definition

Specifies the ionosphere by measuring Electron Density Profiles (EDP), Total Electron Content (TEC), and identify features of the E and F2 regions. (Note: 1 TEC = 10^{16} m^{-2}.)

3.5.12.5.2 P³I Justification

Further study is required to establish the measurement technique and/or benefit of sensing this requirement from geostationary orbit.

Attribute		Threshold	Objective
3.5.12.5.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.5.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Global
3.5.12.5.5	*Spatial / Angular Resolution*	TBS	10 km
3.5.12.5.6	*Mapping Accuracy*	TBS	5 km
3.5.12.5.7	*Measurement Range*	TBS	n_e: 10^0-10^7 cm^{-3}
3.5.12.5.8	*Measurement Accuracy*	TBS	±5%
3.5.12.5.9	*Refresh Rate*	TBS	15 min
3.5.12.5.10	*Data Latency*	TBS	15 min

3.5.12.6 IONOSPHERIC SCINTILLATION

3.5.12.6.1 Definition

The fluctuation of both amplitude and phase of an electromagnetic frequency signal caused by variations in electron density along the transmission path.

3.5.12.6.2 P³I Justification

Further study is required to establish the measurement technique and/or benefit of sensing this requirement from geostationary orbit.

Attribute		Threshold	Objective
3.5.12.6.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.6.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Global
3.5.12.6.5	*Spatial / Angular Resolution*	TBS	25 km
3.5.12.6.6	*Mapping Accuracy*	TBS	5 km
3.5.12.6.7	*Measurement Range*	TBS	Amp. Fluc. Index (S4): 0.1 - 0.5 Phase Fluc. Index: 0.1 - 20 radians (VHF to S-Band Frequencies)
3.5.12.6.8	*Measurement Accuracy*	TBS	S4: 0.1 Phase Index: 0.1 radians
3.5.12.6.9	*Refresh Rate*	TBS	15 min
3.5.12.6.10	*Data Latency*	TBS	<5 min

3.5.12.7 NEUTRAL DENSITY PROFILE

3.5.12.7.1 Definition

Measurements of upper atmospheric densities.

3.5.12.7.2 P^3I Justification

Further study is required to establish the measurement technique and/or benefit of sensing this requirement from geostationary orbit.

Attribute		Threshold	Objective
3.5.12.7.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.7.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Global
3.5.12.7.5	*Spatial / Angular Resolution*	TBS	250 km
3.5.12.7.6	*Mapping Accuracy*	TBS	125 km
3.5.12.7.7	*Measurement Range*	TBS	$2x10^{-19}$ to $5x10^{-9}$ g cm^{-3}
3.5.12.7.8	*Measurement Accuracy*	TBS	<500 km: 5% 500 - 700 km: 10% >700 km: 15%
3.5.12.7.9	*Refresh Rate*	TBS	60 min
3.5.12.7.10	*Data Latency*	TBS	15 min

3.5.12.8 OPTICAL BACKGROUNDS

3.5.12.8.1 Definition

Emissions are the result of interactions between precipitating energetic particles and solar ultraviolet radiation with neutral atmospheric constituents.

3.5.12.8.2 P^3I Justification

Further investigation of whether a minor modification or improvement in other existing GOES-R space requirements/specifications could partially or completely satisfy DOD requirements would be beneficial.

Attribute		Threshold	Objective
3.5.12.8.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.8.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Global
3.5.12.8.5	*Spatial / Angular Resolution*	TBS	10 km
3.5.12.8.6	*Mapping Accuracy*	TBS	50 km
3.5.12.8.7	*Measurement Range*	TBS	Wavelength: 1 - 29 μm 0.4 - 0.7 μm 0.04 - 0.2 μm Brightness: TBS
3.5.12.8.8	*Measurement Accuracy*	TBS	TBS
3.5.12.8.9	*Refresh Rate*	TBS	1 sec
3.5.12.8.10	*Data Latency*	TBS	15 min

3.5.12.9 UPPER ATMOSPHERIC NEUTRAL WINDS

3.5.12.9.1 Definition

Measurement of the horizontal neutral wind in the upper atmosphere. The upper atmosphere is that portion of the atmosphere that is above the troposphere, i.e., generally above 1020 km (612 mi) [*Glossary of Meteorology*].

3.5.12.9.2 P^3I Justification

Further study is required to establish the measurement technique and/or benefit of sensing this requirement from geostationary orbit. In addition, the current planned geostationary architecture does not provide sufficient viewing angle or coverage, other orbital/architectural options will be required for complete coverage.

Attribute		Threshold	Objective
3.5.12.9.3	*User & Priority Category*	OAR-NWS/SEC-UA DoD/All-1	OAR-NWS/SEC-UA DoD/All-1
3.5.12.9.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Global
3.5.12.9.5	*Spatial / Angular Resolution*	TBS	250 km
3.5.12.9.6	*Mapping Accuracy*	TBS	125 km
3.5.12.9.7	*Measurement Range*	TBS	0 to ±1500 m/s
3.5.12.9.8	*Measurement Accuracy*	TBS	Greater of 5 m/s or 5%
3.5.12.9.9	*Refresh Rate*	TBS	0° - 50° N/S: 30 min >50° N/S: 15 min
3.5.12.9.10	*Data Latency*	TBS	15 min

3.5.13 Performance Characteristics: Space / Solar

3.5.13.1 SOLAR FLUX: SPECTRAL IRRADIANCE

3.5.13.1.1 Definition

Spectral radiation measurements at the top of the atmosphere.

Attribute		Threshold	Objective
3.5.13.1.2	*User & Priority Category*	OAR-NWS/SEC-UA	OAR-NWS/SEC-UA
3.5.13.1.3	*Orthogonality/Angular Resolution/Spatial Coverage*	Whole Sun (40 arcmin)	Whole Sun (40 arcmin)
3.5.13.1.4	*Mapping Accuracy*	±1 arcmin	±1 arcmin
3.5.13.1.5	*Mapping Uncertainty*	±0.5 arcmin	±0.5 arcmin
3.5.13.1.6	*Measurement Range*	0 - 10 W/m^2nm	0 - 10 W/m^2nm
3.5.13.1.7	*Measurement Accuracy*	1%	0.1%
3.5.13.1.8	*Refresh Rate*	6 hr	60 min
3.5.13.1.9	*Data Latency*	1 day	60 min
3.5.13.1.10	*Long Term Stability*	<600nm:0.02% per yr >600 nm:0.01%per yr	<600nm:0.01% per yr >600 nm:0.01%per yr

3.5.13.2 SOLAR FLUX: TOTAL IRRADIANCE

3.5.13.2.1 Definition

Total incoming radiation measurements at the top of the atmosphere.

Attribute		Threshold	Objective
3.5.13.2.2	*User & Priority Category*	Climate-1 NWS/NCEP/EMC-2 OAR-NWS/SEC-UA	Climate-1 NWS/NCEP/EMC-2 OAR-NWS/SEC-UA
3.5.13.2.3	*Orthogonality/Angular Resolution/Spatial Coverage*	Whole Sun (40 arcmin)	Whole Sun (40 arcmin)
3.5.13.2.4	*Spatial Coverage / Angular Resolution*	25 km	2 km
3.5.13.2.5	*Mapping Accuracy*	±1 arcmin	±1 arcmin
3.5.13.2.6	*Mapping Uncertainty*	±0.5 arcmin	±0.5 arcmin
3.5.13.2.7	*Measurement Range*	1310 - 1420 W/m^2	1310 - 1420 W/m^2
3.5.13.2.8	*Measurement Accuracy*	1.5 W/m^2 (0.1%)	0.15 W/m^2 (0.01%)
3.5.13.2.9	*Refresh Rate*	60 min	15 min
3.5.13.2.10	*Data Latency*	1 day	15 min
3.5.13.2.11	*Long Term Stability*	0.002% per year	0.0005% per year

3.5.13.3 SOLAR RADIATION IMAGERY / CORONA IMAGES

3.5.13.3.1 *Definition*

Detection of coronal mass ejections and determination of their speed, direction, spatial extent and mass.

3.5.13.3.2 *P^{3}I Justification*

The measurement technique for sensing this requirement from geostationary orbit has been established but would require additional instrumentation. New instrumentation could significantly impact satellite bus structure and program cost. A cost/benefit analysis is required.

Attribute		Threshold	Objective
3.5.13.3.3	*User & Priority Category*	OAR-NWS/SEC-1 DoD/All-1	OAR-NWS/SEC-1 DoD/All-1
3.5.13.3.4	*Orthogonality/Angular Resolution/Spatial Coverage*	3.7 - 17 solar radii (1 - 4.5 ^{o} halfwidth) (Position Angle: >355^{o})	2 - 17 solar radii (0.5 – 4.5 ^{o} halfwidth) (Position Angle: 360 ^{o})
3.5.13.3.5	*Spatial / Angular Resolution*	50 arcsec (TBS)	50 arcsec (TBS)
3.5.13.3.6	*Spatial Spacing/Sampling*	25 arcsec	25 arcsec
3.5.13.3.7	*Mapping Accuracy*	6.25 arcsec during image sequence	6.25 arcsec during image sequence
3.5.13.3.8	*Mapping Uncertainty*	25 arcsec	12.5 arcsec (TBS)
3.5.13.3.9	*Measurement Range*	1 x10^{-11}, 1 x10^{-8} B/B$_{sun}$ (TBS), where B$_{sun}$ is the mean solar brightness	1 x10^{-11}, 5 x10^{-8} B/B$_{sun}$ (TBS), where B$_{sun}$ is the mean solar brightness
3.5.13.3.10	*Measurement Accuracy*	25%	10%
3.5.13.3.11	*Refresh Rate*	15 minutes	15 minutes
3.5.13.3.12	*Data Latency*	15 minutes	1 minutes

3.5.13.4 SOLAR RADIATION IMAGERY / EUV IMAGES

3.5.13.4.1 Definition

Detection of the solar transition region in the extreme ultraviolet (EUV).

3.5.13.4.2 P^{3}I Justification

The technology readiness/cost for sensing this requirement from geostationary orbit requires additional investigation. Additionally, the incremental cost/benefit of multispectral solar imagery needs further study.

Attribute		Threshold	Objective
3.5.13.4.3	*User & Priority Category*	DoD/All-1	DoD/All-1
3.5.13.4.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Whole Sun
3.5.13.4.5	*Spatial / Angular Resolution*	TBS	5 arcsec
3.5.13.4.6	*Mapping Accuracy*	TBS	2 arcsec
3.5.13.4.7	*Measurement Range*	TBS	Wavelength: 10 - 1600 Angstroms
3.5.13.4.8	*Measurement Accuracy*	TBS	±5%
3.5.13.4.9	*Refresh Rate*	TBS	1 min
3.5.13.4.10	*Data Latency*	TBS	1 min

3.5.13.5 SOLAR RADIATION IMAGERY / FAR IR & OPTICAL

3.5.13.5.1 Definition

Detection of the solar transition region in the far infrared (IR) and optical.

3.5.13.5.2 P^3I Justification

The cost/benefit of ground versus space deployment for this requirement needs to be assessed. New space instrumentation could significantly impact satellite bus structure and program cost. Additionally, the incremental cost/benefit of multispectral solar imagery needs further study.

Attribute		Threshold	Objective
3.5.13.5.3	*User & Priority Category*	DoD/All-1	DoD/All-1
3.5.13.5.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Whole Sun
3.5.13.5.5	*Spatial / Angular Resolution*	TBS	1 arcsec
3.5.13.5.6	*Mapping Accuracy*	TBS	TBS
3.5.13.5.7	*Measurement Range*	TBS	Far IR to Optical, H-Alpha, and White Light
3.5.13.5.8	*Measurement Accuracy*	TBS	±5%
3.5.13.5.9	*Refresh Rate*	TBS	1 min
3.5.13.5.10	*Data Latency*	TBS	1 min

3.5.13.6 SOLAR RADIATION IMAGERY / MAGNETO-HELIOGRAPH

3.5.13.6.1 Definition

A full disk, one-dimensional magnetic mapping of the solar surface using the infrared line of Calcium emission as a filter.

3.5.13.6.2 P^3I Justification

The cost/benefit of ground versus space deployment for this requirement needs to be assessed. New space instrumentation could significantly impact satellite bus structure and program cost. Additionally, the incremental cost/benefit of multispectral solar imagery needs further study.

Attribute		Threshold	Objective
3.5.13.6.3	*User & Priority Category*	DoD/All-1	DoD/All-1
3.5.13.6.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Whole Sun
3.5.13.6.5	*Spatial / Angular Resolution*	TBS	1000 km
3.5.13.6.6	*Mapping Accuracy*	TBS	1000 km
3.5.13.6.7	*Measurement Range*	TBS	$2x10^{-3}$ - 0.3 Tesla
3.5.13.6.8	*Measurement Accuracy*	TBS	± $2x10^{-3}$ Tesla
3.5.13.6.9	*Refresh Rate*	TBS	60 min
3.5.13.6.10	*Data Latency*	TBS	15 min

3.5.13.7 SOLAR RADIATION IMAGERY / FLUX: SOLAR RADIO (TOTAL FLUX & BURST LOCATION)

3.5.13.7.1 Definition

Amount of radio frequency energy passing through a certain area. The Burst location identifies where on the sun it originated.

3.5.13.7.2 P^3I Justification

The cost/benefit of ground versus space deployment for this requirement needs to be assessed. New space instrumentation could significantly impact satellite bus structure and program cost.

Attribute		Threshold	Objective
3.5.13.7.3	*User & Priority Category*	DoD/All-1	DoD/All-1
3.5.13.7.4	*Orthogonality/Angular Resolution/Spatial Coverage*	TBS	Whole Sun
3.5.13.7.5	*Spatial / Angular Resolution*	TBS	1° Helio-centric
3.5.13.7.6	*Mapping Accuracy*	TBS	1° Helio-centric
3.5.13.7.7	*Measurement Range*	TBS	Freq. Range: 25 kHz - 300 GHz Ant. Temp: 108 - 1012 K
3.5.13.7.8	*Measurement Accuracy*	TBS	±5%
3.5.13.7.9	*Refresh Rate*	TBS	1 min
3.5.13.7.10	*Data Latency*	TBS	1 min

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3.6 PRODUCT AND DATA DISTRIBUTION REQUIREMENTS

The distribution of GOES-R data and products is a highly complex function. Data and products must be delivered or made available to a range of users having everything from state-of-the-art super computers to personal computers. Figure 3-1 illustrates the distribution of data and products to users. User categories include NOAA and Department of Defense national centers for numerical modeling, other NOAA Line Office users, such as NWS and NOS field offices, other Federal Agency users such as Department of Energy, Department of Interior, and Department of Agriculture, and non-U.S. Governmental agencies such as the weather services of the Western Hemisphere Countries. In most cases, the requirements are for the availability of data ("pull mode"), rather than a continuous stream of data ("push" mode) such as is required for the national modeling centers. In the following sub-sections, these requirements are sorted according to user.

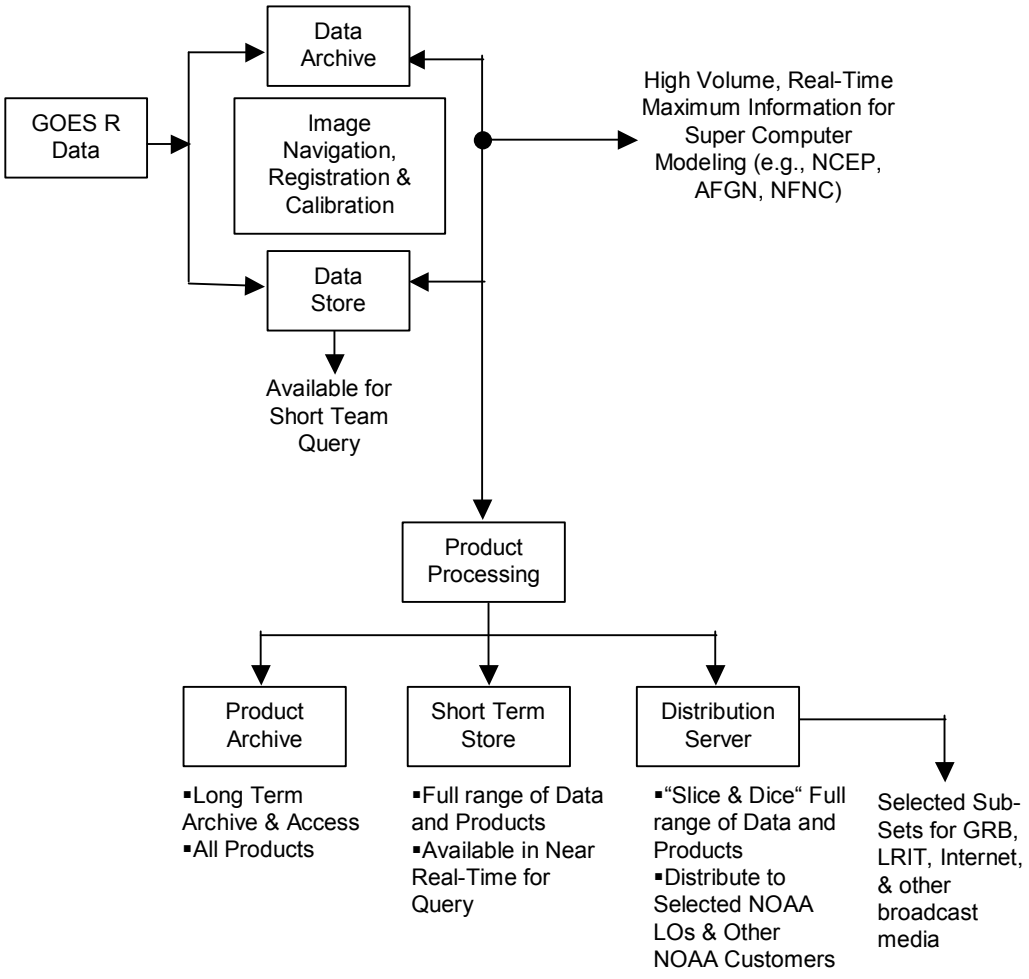

Figure 3-1. Data and product distribution functional architecture.

3.6.1 NOAA Line Office Requirements (tbw)

3.6.2 Other U.S. Federal Agency Needs (tbw)

3.6.3 Other non-U.S. Federal Agency Needs (tbw)

3.6.4 Other non-U.S. Agency Needs

NOAA supports the U.S. Government's policy providing for the full and open exchange of meteorological data.. This policy regarding the exchange of meteorological data is consistent with existing law and policy reflected in the Paperwork Reduction Act and OMB Circular A-130. It is also consistent with World Meteorological Organization's (WMO) resolutions and as well as NOAA's stated goal to "maximize the mutual benefits of international exchange with our Global partners." (*New Priorities for the 21st Century: NOAA's Strategic Vision*).

The rebroadcast of GOES-R data to users throughout the Western Hemisphere and elsewhere is in the spirit of U.S. law and policy, and WMO resolutions, in addition to the general NOAA effort to promote increased international cooperation and coordination in Earth observation activities.

3.7 DIRECT SERVICES REQUIREMENTS

Historically, NOAA has provided a number of direct services from its satellites to various users. Equivalent or better services will be required to continue in the GOES-R era. However, some of them may be provided in other ways than from geosynchronous orbiting satellites. The direct services include Search and Rescue, Emergency Managers Warning and Information Network (EMWIN) broadcast, Low Rate Image Transmission (LRIT) broadcast, data collection services, and GOES Re-Broadcast (GRB), a broadcast of selected images and products previously known as GVAR. The requirement for each service is detailed in the following subsections.

3.7.1 Search and Rescue Requirements

The United States Government, specifically the DOC's NOAA, U.S. Air Force, and the U.S. Coast Guard (USCG) requires an enduring space-based capability to detect, locate, and relay distress alerts from emergency beacons carried by aviators, mariners and land-based users. The alerts include information about the user, as well as position information when available.

The Government requires the capability to support the general public, to support civilian search and rescue (SAR) efforts of the USCG and the USAF, to support military SAR operations, and to meet international obligations under the Chicago Convention (under the auspices of the International Civil Aviation Organization, the Safety of Life at Sea Convention and the Maritime Search and Rescue Convention (both under the auspices of the International Maritime Organization, IMO).

The United States National Search and Rescue Plan states the responsibilities of the various agencies in supporting the national SAR infrastructure. The National Search and Rescue Committee (NSARC) coordinates the implementation of the national SAR Plan, as well as develops relevant polices and procedures. The United States Search and Rescue Satellite Aided Tracking (SARSAT) and the international COSPAS-SARSAT programs meet the needs of the Government in detecting and locating emergency beacons. The applications include emergency position-indicating radio beacons (EPIRB) for maritime users, emergency locator transmitters (ELT) for aviation users, and personal locator beacons (PLB) for inland users.

The system performance required (described as performance parameters) and the rationale behind the requirement are summarized in Table 1. The minimum requirement is considered a threshold while the objective describes the desired performance level.

Table 1. Required System Performance: SARSAT

Performance Parameter	Threshold	Objective	Comments
Communications 406 MHz	One-way	One-way	
Detection Probability	99.5%	99.9%	406 MHz Beacons
Location Probability	98%	99%	406 MHz Beacons equipped with auxiliary location devices only
Timing (Data Latency) No position Position	<5 min <30 min	<5 min <5 min	406 MHz Beacons Position requirements for 406 MHz Beacons equipped with auxiliary location devices only
Position Accuracy 406 MHz	P(e <5 km) 95%	P(e <2 km) 95%	406 MHz Beacons equipped with auxiliary location devices only
Availability	99.5%	99.9%	
Coverage 406 MHz	Earth coverage	Earth coverage	Maximum Area Possible
Capacity	3.8 M Beacons	10 M Beacons	406 MHz Beacons

SARSAT is a Priority Category 1 direct service.

3.7.2 Emergency Managers Weather Information Network (EMWIN) Requirements

The Emergency Managers Weather Information Network (EMWIN), is a direct service that provides users with weather forecasts, warnings, and other information directly from the National Weather Service (NWS) in almost real time. EMWIN is used primarily by emergency managers and public safety officials who require timely weather information to make critical decisions. EMWIN is a fully operational service supported by the NWS in partnership with the Federal Emergency Management Agency (FEMA) and other public and private organizations. Additionally, everyone with an appropriate receiving system and a personal computer can be an EMWIN user. Therefore, providing an exact count of EMWIN users is not possible. However, EMWIN data relay through GOES-R is expected to be required by several thousands of users.

EMWIN consists of:

1) An around-the-clock data feed of current weather warnings, watches, advisories, forecasts, and other products issued by the National Weather Service and images provided by NESDIS.

2) A suite of methods to obtain this data feed and display the products on the user's personal computer.

Two of the methods for obtaining the EMWIN feed are direct satellite broadcast and repeat radio broadcast. With direct satellite, the EMWIN feed is received directly from one of the satellites broadcasting the signal. With repeat radio, the feed is received from a repeat broadcast (usually VHF), which comes from an existing direct satellite receive site. EMWIN user systems can be programmed to sound an alarm in cases of severe weather.

Currently, the NWS EMWIN datastreams are broadcast on GOES East and West Satellites. Data are uplinked to satellite from the NOAA Command and Data Acquisition (CDA) Station on Wallops Island, VA. The GOES downlink frequency used for the 9600 baud EMWIN datastream on the GOES-I/M series is 1690.725 MHz, 275 KHz lower than the standard WEFAX 1691.0 MHz signal. The signal is passed through a down converter, received as if a radio signal at 137.225 MHz, and then demodulated to 9600 baud. In the GOES-N series, the EMWIN data will be broadcast on a separate channel at 1693 MHz. It is anticipated the modulation technique used in the GOES-N series will enable the service to be operated at 19.2 kbps. The Binary Phase Shift Keying (BPSK) modulation and the Forward Error Correction using Reed-Solomon/Convolutional technique used in the GOES-N series will be carried over to the GOES-R series. This expanded bandwidth will still be inadequate to broadcast all the information required by users.

The Threshold Requirement for EMWIN bandwidth is 19.2 baud and the Objective Requirement is 56 kbps. The Data Latency Threshold Requirement is 2 seconds and the Objective Requirement is 1 second. EMWIN is a Priority Category 1 direct service. See Table 2.

Table 2. Required System Performance: EMWIN

Performance Parameter	Threshold	Objective	Comments
Bandwidth	19.2 kbps	56 kbps	Current 9.6 kbps is inadequate
Modulation	BPSK	BPSK	Maintains current characteristics
Forward Error Correction	Reed-Solomon/ Convolutional	Reed-Soloman/ Convolutional	Maintains current characteristics
Downlink Frequency	1693 MHz	1693 MHz	Maintains current frequency

3.7.3 Low Rate Image Transmission Requirements

The Low Rate Information Transmission (LRIT) direct service currently broadcast from the GOES-I/M and N-Q series of satellites disseminates GOES, Polar Orbiting Environmental Satellite (POES) and foreign satellite meteorological data and products to users. As participants of the international WMO program for the broadcast of digital meteorological satellite, the United States and other countries are required to operate satellite broadcast systems conforming to the WMO CGMS LRIT broadcast standards so the users' requirements for seamless interoperability among satellites operated by European and Asian nations can be satisfied.

The current LRIT data stream is comprised of three components: the satellite images and derived products originating in GOES, POES and foreign satellites; watches, warnings, forecasts, graphics, and other hydrometeorological products originating in the National Weather Service; and observations and other products originating in the NESDIS GOES Data Collection System (DCS). The content of the DCS data stream is a rebroadcast of selected DCS observations and other products that have received further processing by the DCS Automatic Processing System (DAPS). The requirement for the contents of the LRIT data streams are established by the NOAA Services Oversight Panel that ensures the bandwidth resources are managed to maximize satisfaction of user requirements. The Services Oversight Panel is co-chaired by staff of NESDIS and the NWS.

The 128 kbps bandwidth of the current LRIT GOES-N broadcast is inadequate to meet the data requirements of the users. The Threshold and Objective Requirements for LRIT bandwidth in the GOES-R series is 512 kbps. The Data Latency Threshold and Objective Requirements are 5 seconds. The LRIT direct service operates at 1691.4 MHz. The sizes of the LRIT products vary greatly from a few hundred Bytes (DCS observations) to Mega Bytes (satellite images). The Power Threshold and Objective Requirements Gain over Temperature (G/T) is –0.3 dB/K with a 1 to 2 meter antenna. LRIT is a Priority Category 1 direct service.

Table 3. Required System Performance: LRIT

Performance Parameter	Threshold	Objective	Comments
Bandwidth	512 kbps	512 kbps	Current 128 kbps is inadequate
Modulation	BPSK	BPSK	Maintains current characteristics
Forward Error Correction	Reed-Solomon/ Convolutional	Reed-Soloman/ Convolutional	Maintains current characteristics
Data Latency	5 sec	5 sec	
Frequency	1691.4 MHz	1691.4 MHz	Maintains current frequency
Power Threshold	-0.3 dB/K	-0.3 dB/K	1 - 2 meter antenna

3.7.4 Data Collection Service Requirements

GOES Data Collection System (DCS) is a relay system used to collect information from earth-based platforms and deliver the information to a central processing and communication system. The platforms can be placed in remote locations and left to operate with minimal human intervention. This allows observations from sites that may not be accessible to humans during parts of the year or where conventional communications are not practical. It also allows for more frequent and more geographically complete environmental monitoring than most agencies could fund if each site were staffed. Also, the DCS provides access to a broader suite of parameters than can be currently observed using satellite radiometers. The platforms transmit an electronic signal, containing the environmental data observed by the sensors on the platform, at predefined frequencies and times.

The transponder on board the satellite is required to detect the signal and then rebroadcast the signal so it can be received by the ground equipment at the Wallops Command and Data Acquisition (CDAS) station, in Wallops Island, Virginia for processing and distribution by the DCS Automatic Processing System (DAPS). The signal containing the reports from the platforms

also is received directly by other users, primarily platform owners, operating receiving equipment with the correct configuration.

The geographic coverage for the DCS direct service must include the area between 90º N and 70º S and between 20º W and 160º E. The messages originating at the platforms vary in size from 200 to 2000 Bytes each.

The DCS Threshold Requirements are: 89,100 platforms; 4 transmission per hour; 300 bps; data latency of 5 minutes; transmission timing accuracy of 5 seconds; and a data error rate of 10^{-5}. The DCS Objective Requirements are: 158,000 platforms; 4 transmissions per hour; 1200 bps; data latency of 1 minute; transmission timing accuracy of 1 second; and a data error rate of 10^{-7}. DCS is a Priority Category 1 direct service.

Table 4. Required System Performance: DCS

Performance Parameter	Threshold	Objective	Comments
Platforms	89,100	158,000	
Transmissions	4 per hour	4 per hour	A small number of platforms require transmissions as frequently as every 5 minutes
Message Size	200 Bytes	1000 Bytes	A small number of platforms require message sizes as large as 30 K Bytes
Bandwidth	300 bps	1200 bps	A small number of platforms require bandwidth as high as 128 Kbps
Timing (Data Latency)	5 min	1 min	
Transmission Timing Accuracy	5 sec	1 sec	
Data Error Rate	10^{-5}	10^{-7}	
Geographic Coverage	90º N to 70º S 20º W to 160º E	90º N to 70º S 20º W to 160º E	

For specific user requirements see Appendix A/DCS.

3.7.5 GOES Re-Broadcast Requirements

The GOES Variable Format (GVAR) broadcast is required to be continued in the GOES-R series to support the existing users with minimal impact. The GOES-R system will provide many more products of the type currently broadcast on GVAR. To provide these additional products to users, a second GOES Re-broadcast of a selected set of data and products tailored for maximum benefit to a large number of users and tailored for maximum efficiency of the retransmission system will be provided.

The GVAR Re-Broadcast of approximately 2 Mbps will be a partial Advanced Baseline Imager dataset created by sub-setting the full set by using only the current spectral bands, and by selecting only certain times or areas and/or by compressing the data.

The additional products, broadcast in the additional GVAR bandwidth, may consist of ABI data only or selected ABI data with compressed HES-IR or compressed HES-IR plus compressed HES-CW, or lossless compressed HES-CW data.

The requirements for the contents of the GVAR data streams are established at the time of operations by the NOAA Services Oversight Panel that ensures the bandwidth resources are managed to maximize satisfaction of user requirements. The Services Oversight Panel is co-chaired by staff of NESDIS and the NWS.

Table 5. Required System Performance: GOES Re-Broadcast

Performance Parameter	Threshold	Objective	Comments
GVAR Bandwidth	2 Mbps	2 Mbps	Preserves the current GVAR broadcast
Additional GVAR Bandwidth	14 Mbps	30 Mbps	

3.7.6 National Marine Sanctuaries Telepresence Requirements

One limitation of the marine environment—especially the underwater environment—is that relatively few individuals can ever experience it directly. By bringing national marine sanctuaries to the public, rather than the other way around, a vastly greater audience can see for themselves why the ocean environment is so valuable. The sanctuary program is currently making this connection through a new, technology-based education, outreach and science initiative called Telepresence.

Telepresence allows individuals living far from the coastal zone to experience up-close the wonders of these special marine areas without ever getting their feet wet. Under the Telepresence program, underwater cameras and scientific monitoring equipment are installed within sanctuaries and use a live, interactive video feed to support education programs, exhibits in aquaria and visitor centers, and Web-based learning tools. As the numbers of outreach programs using this technology increase, so too will the number of Americans able to experience first-hand these important marine and Great Lakes areas. Many of these individuals will be in communities currently underserved by existing marine education programs, including minority populations and communities located far inland.

A successful Telepresence pilot began operating in Monterey Bay National Marine Sanctuary in 2002, allowing visitors at the Mystic (Conn.) Aquarium's "Immersion Theater" to view and operate, in real time, a remotely operated vehicle tethered near a kelp forest in 50 feet of water. The popular exhibit has introduced thousands of visitors to the underwater wonders of the Monterey Bay ecosystem.

The program is partnering with aquaria, research institutions, and a variety of private and federal partners to expand this exciting technology to the Channel Islands, Florida Keys and Thunder Bay sanctuaries over the next two years. The Marine Sanctuary vision is to establish a Telepresence capability at all 13 National Marine Sanctuaries. Providing a 1 Mbps network connection to each of the 13 sanctuaries translates to GOES Threshold and Objective requirements of 13 Mbps. Telepresence is a Priority Category 3 direct service.

Table 6. Required System Performance: Telepresence

Performance Parameter	Threshold	Objective	Comments
Bandwidth	13 one Mbps channels	13 one Mbps Channels	
Connectivity	13 Marine Sanctuaries	13 Marine Sanctuaries	

3.7.7 NMAO Ship and Aircraft Requirements

Reliable voice and data communications between the NOAA operational aircraft and ships and ground /shore facilities is a necessary requirement for all missions. Voice communications are used frequently by NOAA aircraft. Historically, aircraft voice communications have used only VHF and HF radio, but currently commercial aircraft satellite communications systems have become affordable and systems have been added to the larger aircraft.

Until recently, data communications on the two WP-3D aircraft was limited to a one-way, 125 baud data link over the ASDL (Aircraft Satellite Data Link) using GOES. This extremely reliable path for transmitting a limited amount of near real-time data from the aircraft to the established data distribution networks within NOAA has worked well for transmitting a set of rigidly formatted data products, but the bandwidth is very limiting. This system uses a single channel, 125 baud data link, time-sliced into 5 minute increments, shared between the two WP-3D aircraft. Radar image products generated onboard the aircraft are reduced in resolution and compressed, and other data products are reduced in resolution to meet available bandwidth restrictions. New products can be added to the ASDL data stream but only by removing existing products. 300 and 1200 baud capability is now available on the satellite, but transmitters approved for aircraft use are not yet available.

In 1996, NOAA acquired the G-IVSP aircraft, which was equipped with an Inmarsat, Aero-H voice and two-way 2400 baud data capability. The voice capabilities of this system are good, but the data capability is expensive and unreliable. Recently available commercial data communications capabilities (Globalstar and Iridium) have been added to the WP-3Ds and the G-IVSP resulting in improved two-way data communications, providing a backup for ASDL, additional bandwidth available for transmission of enhanced product sets, Internet access for downloading mission related data, and email access.

Ships benefit from increased access to satellite channels by improving the efficiency and frequency of communication systems on board. Currently, NOAA ships purchase commercial satellite access to download emails and transmit data at a cost of nearly half a million dollars per year. Due to the costs involved, most ships limit downloading of email and/or transmission of data to once or twice a day and the security of satellite transmissions are not ensured. The NOAA Marine and Aviation Operations (NMAO) requires each ship to have access to their own satellite channel on GOES which would provide the instantaneous transmission of oceanographic, fisheries or hydrographic survey data collected on ships and sent real-time to labs and processing centers on shore. This would significantly speed up the processing of data and increase the volume of data that can be transmitted resulting in greater efficiency and improved products.

Video feeds using a satellite channel from NOAA ships would enable first stage medical aid to be delivered in the event of an emergency when a ship is away from port. The video capabilities would also support the Teacher at Sea program and other outreach efforts greatly benefiting NOAA's outreach and education efforts. Using the satellite channel for a wireless connection to the Internet would provide ship personnel much improved access to email and news reports from the world that would improve the Quality of Life on board NOAA ships and represent a step toward improving crew retention rates.

The Threshold Requirements for NMAO are for an ultra-reliable, dedicated one-way data link with a bandwidth of 9600 baud and a two-way link allowing wireless networking between NOAA aircraft and ships and scientists located at ground / shore based facilities with a bandwidth of 64 kbps. The Objective Requirements for NMAO are for a one-way data link with a bandwidth of 64 kbps and a wireless network connection with a bandwidth of 64 kbps. NMAO ship and aircraft support is a Priority Category 1 direct service.

Table 7. Required System Performance: NMAO

Performance Parameter	Threshold	Objective	Comments
One-Way Data Link	9600 bps	64 kbps	Current 2.4 kbps is inadequate
Wireless Networking with Ground / Shore Facilities	64 kbps	64 kbps	

3.8 ARCHIVE SEGMENT REQUIREMENTS

NOAA NESDIS will provide permanent stewardship of GOES-R observed data and selected derived data products. An integrated systems approach is required which encompasses all aspects of retrospective data management including: ingest; near-real -time and retrospective customer access and distribution; permanent, protected storage; product development and enhancement support; data sharing with other NOAA and non-NOAA data management systems; and data reprocessing.

Currently, NESDIS operates and is further developing the Comprehensive Large-Array Stewardship System (CLASS) for high volume data streams, including GOES. It is anticipated that CLASS or subsequent evolutions of a CLASS-type system will fulfill all of the technical requirements of the GOES-R era. Upgrades to the then existing CLASS will be required to fulfill GOES-R data ingest, distribution, and reprocessing rates projected. This will be performed by evolving CLASS and not by developing a new data management system or systems.

3.8.1 Data Ingest

Level-1 GOES Imager and Sounder data and derived Level 2+ products will be acquired or ingested by the Archive Segment as available from acquisition ground systems and/or from real-time operational environmental product processing systems. This phase may or may not be integrated into the real-time processing and distribution of GOES-R data, but will satisfy customer requirements for near-real-time (1 to 2 hours from observation) access. Ingest will operate on a 24 hour, 7 days per week basis. Redundancy of operations is required to ensure continuity of operations.

3.8.2 Data Processing

All data and data product streams will be cataloged or inventoried as ingested by the Archive Segment. At a minimum, such cataloging will be at a sufficient granularity to allow access and distribution of subsets as required by retrospective customers, including data reprocessors. All external systems, including non-NOAA systems which may be integrated with the GOES-R Archive Segment, will be provided immediate access to catalog information as created.

Blended products, including GOES-R time series as well as products that integrate GOES data with other data streams such as POES or in-situ instrumentation will be created. Such products, though not currently specified, are evolutionary under CLASS. The capability to create these products will continue into the GOES-R era. All such blended products will be cataloged with sufficient granularity to allow access and distribution. As with catalog information, immediate access to all derived products by NOAA and non-NOAA integrated systems will be provided.

3.8.3 Data and Information Distribution

Data and data products will be made available for distribution to customers as ingested, cataloged, and/or created. Two modes of operations are required: pre-defined, automated distribution to NOAA and non-NOAA customers (subscription or integrated services); and customer directed, on-line distribution services.

Customer directed services will include both electronic distribution and distribution on computer compatible media. Electronic distribution will take the form of both "customer active" (pull) or "NOAA active" (push) data streams. Computer compatible media will take the form of whatever magnetic, optical, or other distribution media are prevalent in the GOES-R era.

All metadata associated with the GOES-R platforms, sensors, data streams, and data products will be made available for both electronic and off-line distribution upon request. At a minimum, such metadata will include calibration, validation, and navigation information such that sensor data may be reprocessed into new data or data product streams by retrospective scientists and engineers. Such metadata will also include data product algorithms and product history (errors, data gaps, etc.) for retrospective evaluation and analysis.

3.8.4 Data Archiving

Data will be stored on appropriate archival media for permanent storage. Such media will satisfy the then current standards for stewardship of data, including data permanency, accuracy of retrieval, and speed of storage and retrieval. At a minimum, such media will be capable of satisfying the data ingest rates required in the GOES-R era, as well as those rates required by retrospective products created within the Archive Segment.

Full redundancy of archived data is required. Under data stewardship security, this redundancy will include, at a minimum, two disparate physical locations. The redundant facilities will be integrated such that they are perfectly mirrored in both processing capability and data holdings at any point in time.

The Archive Segment will also archive metadata associated with the collection and processing of GOES-R data and data products. Such metadata include, but will not be limited to, algorithms associated with each product; platform health and status by time; platform and sensor technical documentation; and sensor calibration information.

3.8.5 Data Reprocessing

Data reprocessing in the GOES-R era should be commonplace. Although the volumes of observed data will be far greater than currently ingested, computer technology is projected to evolve to a state where such volumes can be re-ingested and new algorithms applied as required. The Archive Segment will support such reprocessing by providing access-on-demand to high volume Level 1 data and/or subsets of data. Such demand will take the form of fully coordinated, pre-approved access and distribution.

Data reprocessing will be required by both NOAA and non-NOAA scientists and engineers. For NOAA, such reprocessing will assist in the development of new or enhanced products, as well as for evaluation of current and future GOES sensors. Partnerships for reprocessing in the GOES-R era will include DoD and NASA for integration and development of parallel NPOESS/GOES processing and with NASA for integration with EOS and EOS follow-on platforms. Other reprocessing partnerships with federal agencies and the academic community are anticipated.

3.8.6 Archive Segment Management

The Archive Segment will be managed under normal NESDIS data management operations. This includes organizational oversight by the NESDIS Data Archive Board (DAB)) or its successor. Operational oversight will be provided through daily operations of CLASS or its successor. This includes operating, upgrading, and maintaining all Segment phases and providing direct response through customer feedback. CLASS is, and is expected to continue to be operated under a strict configuration management (CM) process.

A Technical Advisory Panel (TAP) will be implemented to direct and assist in the conversion of requirements into technical specifications for development, integration, and operation of the GOES-R Archive Segment. The TAP will assist in the planning of the Data Archive Segment and in the integration of GOES-R into CLASS and its potential successor. The TAP will also assist in the coordination of potential integration of the Archive Segment with NPOESS, EOS, and other envisioned or emerging large-scale data management systems, including automated GOES Reprocessing systems.

3.9 USER INTERFACE SEGMENT REQUIREMENTS

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4 COST/BENEFIT ANALYSIS

The following was excerpted from the Executive Summary of the Geostationary Operational Environmental Satellite System (GOES) GOES -R Sounder and Imager Cost/Benefit Analysis (CBA):

Approximately 20 percent of the United States economy, or two trillion dollars per year [Dutton] is weather sensitive. Each year, the U.S. suffers billions of dollars in losses due to lost time; property and crop damage and lost lives due to weather and environmental conditions, e.g.,

- In the commercial aviation community, weather is responsible for approximately two-thirds of air carrier delays, a cost of $4 billion annually, $1.7 billion of which is *avoidable* [National Aeronautics and Space Administration, http://awin.larc.nasa.gov].
- In 1997, the Red River Floods caused more than $400 million in losses when the Red River rose several feet above projected levels [Disaster Information Task Force].
- In 2000, $9 billion in crop damage was incurred due to weather (e.g., floods, convective weather, winter storms, drought, and fire weather) [National Weather Service].

However, some proportions of these losses are avoidable with improved environmental information, and some proportion of the improved environmental information is attributable to enhanced satellite technology and performance. Improvements in satellite performance that, for example, (1) result in the ability to better predict with increased lead time and accuracy, the location of severe weather manifestation; (2) provide increased temperature accuracy; and (3) offer improved monitoring of volcanic ash, can result in substantial economic benefits to a variety of public sectors. These economic benefits result from the ability of the data users to improve their operational decision-making. For example, airlines will make safer and more efficient routing decisions; the agricultural sector can make crop selection decisions and realize irrigation efficiencies; and, the utilities industries can improve the accuracy of their energy load forecasting decisions.

The National Oceanic and Atmospheric Administration's (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) is developing the next -generation Geostationary Operational Environmental Satellites (GOES -R), which are expected to provide significant advances in earth coverage and weather and environmental information and prediction capabilities. Two of the key instruments within this GOES suite of sensors are the Advance Baseline Imager (ABI) and Hyperspectral Environmental Sounder (HES). To provide a firm foundation for the formulation of instrument development and procurement budgets, NOAA initiated an analysis of the marginal cost and benefit differences (in economic terms) between continuation of instruments with similar performance to today's imager and sounder and the planned GOES-R imager and sounder. The benefits from improved data and products will not only be critical to the economic well being of our users but will further national interests such as homeland security and national well being. New instruments for the GOES -R series will need to be developed because the imagers and sounders in service from now through 2012 cannot be replicated due to obsolescence of key components. Off-the-shelf instruments with similar capabilities would not allow us to incorporate any new technologies.

From a benefits perspective, selected case studies were developed that describe changes in economic impacts (i.e., marginal benefits) due to the proposed changes in the instruments. The expert knowledge and judgement of NOAA engineering staff, scientists, and product managers provided information on ABI and HES performance changes relative to the current imager and sounder, and product improvements based on these performance changes. Information on

economic benefits (primarily *avoided* costs) from these product improvements were obtained via public meetings, discussions, and interviews with GOES constituents and published literature and economic data pertaining to decisions based on this weather data. Published economic data used in the benefit analysis were not independently validated.

The case studies presented in this report represent key economic sectors (agriculture, aviation, electric power and natural gas generation, recreational boating, and trucking) and ***constitute a fraction of potential benefits*** that can be realized from improved GOES data. Thus, notwithstanding the limitations of the estimation techniques used, these estimates represent a ***lower bound*** to the true dollar value for potential benefits.

All costs are presented in fiscal year 2002 dollars, and the time frame under which the analysis is considered is 2012 to 2027 (15-year lifecycle). It was assumed that the advanced imager and sounder instruments will be launched in mid-2012 and the required infrastructure to make effective use of improved data from these instruments will be in place in the 2012 time frame. However, it was further assumed that benefits do not begin until 2015, to allow lag time for model revision and testing to take advantage of and have more confidence in the improved instrument data.

Time will be needed after launch, checkout, and calibration before better economic decisions are likely to commence based on the new data. There is a limit to how much can be done to modify forecast models and products prior to launch. Time is needed to complete these modifications, and to test, validate, and verify improvements in forecasts and other products using actual advanced imager and sounder data. It will also take time to educate users and constituents as to the improvements.

Finally, it will take time for users to gain confidence in the real-world accuracy and applicability of these improvements before they will be willing to make potentially costly economic decisions based on these product improvements. These processes can proceed in parallel to some extent, and some benefits could start earlier and some later.

It is important to note that the case studies developed and presented in this paper represent just a sampling of economic sectors and domains within those sectors from which economic benefits can be realized. The *total* potential marginal discounted benefits to the United States from GOES-R have not been estimated in this paper. However, the total annual marginal benefits from the eight cases discussed in this report show combined annual marginal economic benefits from ABI and HES are approximately $638 M annually (2002 dollars) and a discounted (present value) sum-of-direct benefits of approximately $3.1B across a 13-year effective benefit lifecycle. The Office of Management and Budget (OMB) guidance in circular A-94 states that the criterion to be used to decide if an investment is economically justified is whether or not the estimated Net Present Value (NPV) is positive (greater than zero). To appropriately calculate the NPV, the present value of benefits must be reduced by the marginal costs for ABI and HES (that is, the costs over an above what it would cost to reproduce the current imager and sounder capability). These costs are currently being calculated.

It should be noted that these benefits do not include the potential benefits from the consumer value of water, which is briefly addressed at the end of this paper and which has been valued [Booth] in the billions of dollars.

APPENDIX A. OBSERVATIONAL REQUIREMENTS MATRIX

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APPENDIX C. GLOSSARY OF TERMS

Coastal	Coastal coverage refers to the areal extent consistent with the U.S. Exclusive Economic Zones (EEZ) that extend 370 km from shore. Coastal waters defined as far inland as the top of the watershed.
CONUS	Contiguous U.S. rectangle, 3000 km N/S by approx 5000 km E/W. It has a Target Area of 4000 km for the northern boundary and 6000 km for the southern boundary, and is centered at 38.2º N Lat and 96º W Lon.
Data latency	The time from completion of on-board instrument measurement until the data is available to a primary user.
Full disk	A region defined as the combined earth area viewed from the nominal GOES-R system longitudinal positions.
Global Coverage	Global Coverage; self-explanatory.
Hemispheric Coverage	West Boundary of 150ºE and an East Boundary of 0º Meridian.
Mapping accuracy	The error in navigation between the located coordinates and the fixed coordinates.
Measurement precision	The standard deviation of a statistically meaningful number of samples of a measurement.
Mesoscale Coverage	1000 km N/S x 1000 km E/W Relocatable Target Area within Hemispheric Coverage Area; "Non-Routine" Coverage.
Objective	A requirement that if met, would greatly enhance the utility of the system.
	Farther than 100 km offshore.
Priority Category	"1" = Mission Critical / Cannot meet operational mission objectives without this data "2" = Mission Optimal / Data not critical but would provide significant improvement to operational capability "3" = Mission Enhancing / Needed to enhance state of knowledge / assess potential for operational capability "UA" = Unassigned
Threshold	The minimum acceptable requirement. All requirements expressed in this document are threshold unless stated as an objective.

APPENDIX D. ACRONYMS

ABI	Advanced Baseline Imager
ABS	Advanced Baseline Sounder
ACARS	Aircraft Communications Addressing and Reporting System
AF	Air Force
AFWA	Air Force Weather Agency
AMS	American Meteorological Society
A_O	Operational Availability
AOML	Atlantic Oceanographic and Meteorological Laboratory (OAR)
AOR	Area of Responsibility
arcmin	arc minute. A unit of angular measure in which there are 60 arc minutes in 1 arc degree. An arc degree is a unit of angular measure in which there are 360 arc degrees in a full circle.
arcsec	arc second. A unit of angular measure in which there are 60 arc seconds in 1 arc minute and therefore 3600 arc seconds in 1 arc degree. One arc second is equal to about 725 km on the Sun. An arc degree is a unit of angular measure in which there are 360 arc degrees in a full circle.
ASDL	Aircraft Satellite Data Link
ASOS	Automated Surface Observing System
AWC	Aviation Weather Center (NWS)
BPSK	Bisphase shift keying
BUCDAS	Backup CDAS
C	Carbon
C^3	Command, Control and Communications
C^4I	Command, Control, Communications, Computers, and Intelligence
CAPE	Convective Available Potential Energy
CBA	Cost/Benefit Analysis
CCSDS	Consultative Committee on Space Data Standards
CDAS	Command and Data Acquisition Station
CEOS	Committee on Earth Observations Satellites
CH_4	Methane
CLASS	Comprehensive Large Array-data Stewardship System
cm	centimeter
CM	Configuration Management
CME	Coronal Mass Ejection
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CONUS	Contiguous United States
COOP	Cooperative Observer Program (NWS)
CORAL	Consolidated Observational Allocated Requirements List

COSPAS	Cosmitscheskaja Sistema Poiska Awarinitsch Sudow (Russian: space system for search of vessels in distress)
CPL	Consolidated Product List
CRN	Climate Reference Network
DAB	Data Archive Board (NESDIS)
DCPI	Data Collection Platform Interrogation (DCS)
DCPR	Data Collection Platform Response (DCS)
DCS	Data Collection System
deg	degree
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DoD	Department of Defense
DOORS	Dynamic Object Oriented Requirements System
DSN	Deep Space Network (NASA)
DTED	Digital Topographic Elevation Data
DU	Dobson Unit, the amount of ozone directly above a point on the Earth's surface
EEZ	Exclusive Economic Zone
ELT	Emergency Locator Transmitters
EMC	Environmental Modeling Center
EMWIN	Emergency Managers Weather Information Network
ENSO	El Niño Southern Oscillation
EOS	Earth Observing System (NASA)
EPIRB	Emergency Position-Indicating Radio Beacons
ESA	European Space Agency
EUV	Extreme Ultraviolet
EV	Electron-volt
EVI	Environmental Vulnerability Index
FD	Full Disk
Fe	Iron
FEC	Forward Error Correction
FNMC	Fleet Numerical Meteorology and Oceanography Center
FOC	Full Operational Capability
FSL	Forecast Systems Laboratory (NWS)
g kg^{-1}	grams per kilogram
GAST	GOES Antenna System Tracking
GCMD	Global Change Master Directory (NASA)
GEA	GOES Engineering Analysis
GeV	Giga volt
GOAT	GOES Orbit and Attitude Tracking
GOES	Geostationary Operational Environmental Satellite
GORD	GOES-R Operational Requirements Document
GORWG	GOES Operational Requirements Document Working Group

GPM	GOES Product Monitor
GRB	GOES Re-Broadcast
GS	GOES Scheduling
GSFC	Goddard Space Flight Center (NASA)
GSP	GOES Sensor Processing
GTC	GOES Telemetry & Command
GVAR	GOES Variable Format
He	Helium
Hgt	Height
hPa	hector Pascal
hr	hour(s)
HRD	Hurricane Research Division (OAR)
Hz	Hertz
I & T	Integration and Test
INR	Image Navigation and Registration
IOC	Initial Operating Capability
IOO	Instrument(s) of Opportunity
IORD	Integrated Operational Requirements Document (NPOESS)
IOT&E.	Initial Operational Test & Evaluation
IR	Infrared
K	Degrees Kelvin
KeV	Kiloelectron volt
KI	K-Index
km	kilometer
km/hr	Kilometers per hour
kts	knots, nautical miles per hour
LDE	Long Duration Event
LI	Lifted Index
LO	Line Office
LRIT	Low Rate Information Transmission
Lw	Water-leaving Radiances
LZA	Local Zenith Angle
m/s	meters per second
mb	millibar
MDL	Multi-use Data Link
MetOp	Meteorological Operational Satellite (ESA)
MeV	Millions of electron volts; mega volts
mg m^{-3}	milligram per meters cubed
MHz	Megahertz
min	minute
MK	Mega Kelvin (10^6)
mm	millimeter

mm/hr	millimeters per hour
μm	micron / micrometer, $1x10^{-6}$ meters
MODIS	Moderate Resolution Imaging Spectroradiometer (NASA/EOS instrument)
MPC	Marine Prediction Center (NWS/NCEP)
MRD	Mission Requirements Document
MRS&S	Multi-use Data Link (MDL) Receive System and Server
MTBF	Mean Time Between Failure
MW	Microwave
N	Nitrogen
NASA	National Aeronautics & Space Administration
NCCOS	National Centers for Coastal Ocean Science
NCDC	National Climatic Data Center
NCEP	National Centers for Environmental Prediction
NDVI	Normalized Difference Vegetation Index
Ne	Neon
NESDIS	National Environmental Satellite Data and Information Service
NEXRAD	Next Generation Weather Radar
NGDC	National Geophysical Data Center
NGS	National Geodetic Survey (NOS)
NIC	National Ice Center (NESDIS)
NIR	Near Infrared
nm	nanometer, $1x10^{-9}$ meters
NMAO	NOAA Marine and Aviation Operations
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOHRSC	National Operational Hydrologic Remote Sensing Center (NWS)
NOS	National Ocean Service
NOx	Nitrogen Oxide
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Program
NSARC	National Search and Rescue Committee
NSPD	National Space Policy Directives
NSSL	National Severe Storms Laboratory (OAR)
nT	Nanotesla; a unit of magnetism 10.0E-09 tesla, equivalent to a gamma (10.0E-05 gauss)
NWS	National Weather Service
OAR	Office of Atmospheric Research (NOAA)
OLR	Outgoing Longwave Radiation
NMAO	Office of Marine and Aviation Operations
OMM	Organización Meteorológica Mundial (Spanish: World Meteorological Organization)

ORA	Office of Research and Applications (NESDIS)
ORD	Operational Requirements Document
ORR	Office of Response and Restoration (NOS)
OSDPD	Office of Satellite Data Processing and Distribution (NESDIS)
OSHA	Occupational Safety and Health Administration
P^3I	Pre-Planned Product Improvements
PGD	Product Generation and Distribution
PLB	Personal Locator Beacons
POES	Polar-orbiting Operational Environmental Satellite
PRD	Program Requirements Document
QPE	Quantitative Precipitation Estimates
QPF	Quantitative Precipitation Forecasts
RAWINSONDE	Radiosonde & Radar Wind Sounding
r_e	effective radius
RF	Radio Frequency
RH	Relative Humidity
RT	Real Time
S	Sulfur
SAR	Search and Rescue
SARSAT	Search and Rescue Satellite Aided Tracking
SD	Raw Sensor Data
SEC	NOAA Space Environment Center
sec	second
SEI	Space Exploration Initiative
SEM	Space Environment Monitor
Sfc	Surface
SI	Showalter Index
SO_2	Sulfur Dioxide
SOCC	Satellite Operations Control Center
SOHO	Solar and Heliospheric Observatory (NASA)
SST	Sea Surface Temperature
SXI	Solar X-ray Imager
T	Temperature
TAP	Technical Advisory Panel
TB	Terabyte (1,024 Gigabytes)
TBC	To Be Completed
TBD	To Be Determined (by vendor)
TBR	To Be Reviewed
TBS	To Be Supplied (by government)
TBW	To Be Written
T_d	Dew Point Temperature
TIR	Thermal Infra Red

TOA	Top of Atmosphere
TPC	Tropical Prediction Center (NWS)
TRD	Technical Requirements Document
TT	Total Totals Index
UA -	Unassigned
U.S.	United States
UNESCO	United Nations Educational, Scientific and Cultural Organization (since 1945; Paris, France)
USA	United States Army (DoD)
USAF	United States Air Force (DoD)
USCG	United States Coast Guard
USG	United States Government
USGS	United States Geological Survey
USMC	United States Marine Corps (DoD)
USN	United States Navy (DoD)
UV	Ultraviolet
v_e	effective variance
VIS	Visible
VNIR	visible near infrared
Volcam	Volcanic Ash Mapper
vs	versus
W m^{-2} μm^{-1} sr^{-1}	Watts per (meters squared micrometers steradians)
WBU	Wallops Backup
WFO	Weather Forecast Office (NWS)
Wm^{-2}	Watts per meters squared
WMO	World Meteorological Organisation
yr	year